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SECOND BIHAR STATE IRRIGATION COMMISION 1994

VOLUME I

Objectives and activities of the Commission and summary of important findings and recommendations

GOVT. OF BIHAR

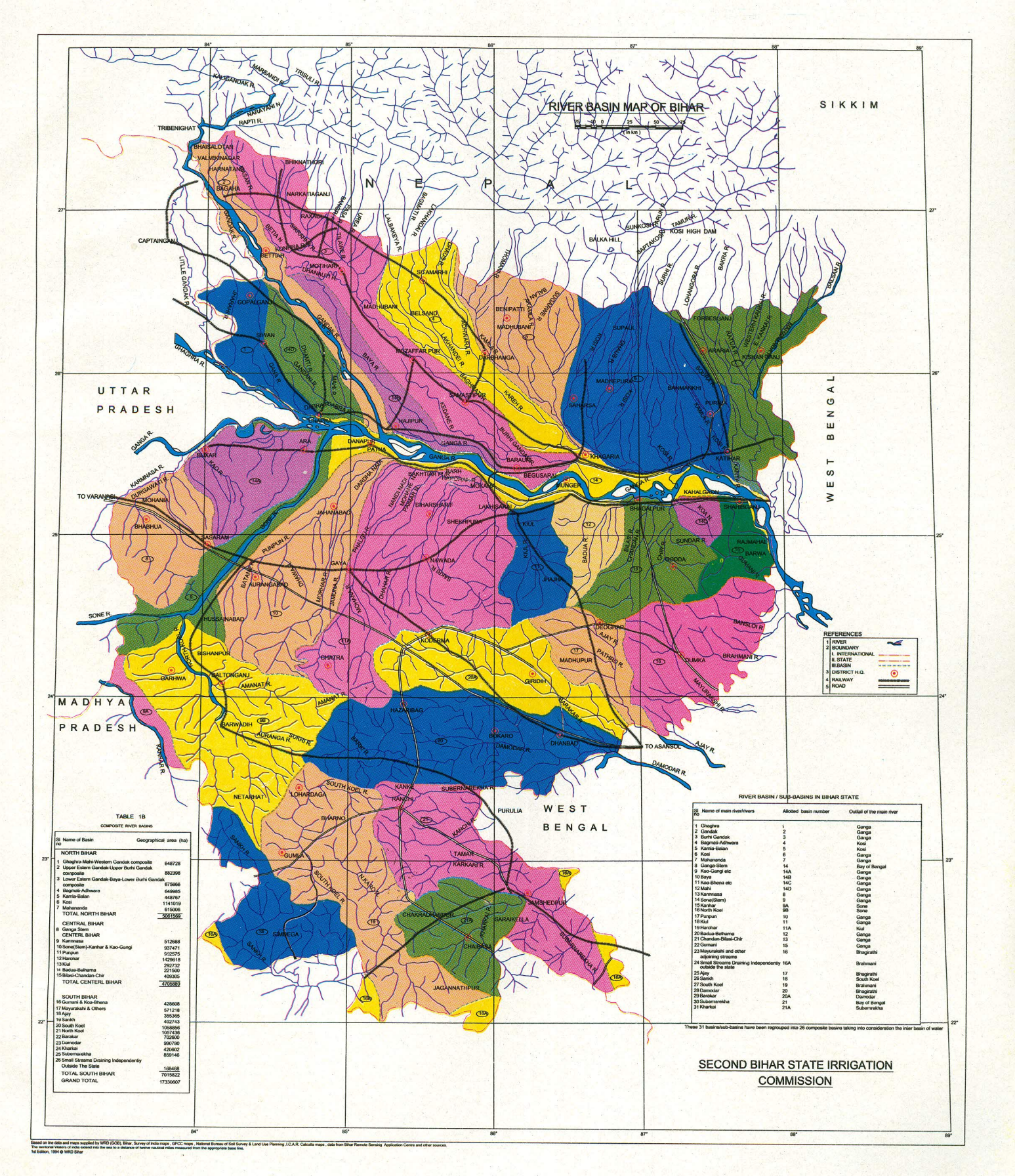

TABLE 1B

COMPOSITE RIVER BASINS

Sl no	Name of Basin	Geographical area (ha)
	NORTH BIHAR	
1	Ghaghra-Mahi-Western Gandak composite	648728
2	Upper Estern Gandak-Upper Burhi Gandak composite	882398
3	Lower Estern Gandak-Baya-Lower Burhi Gandak composite	675666
4	Bagmati-Adhwara	649985
5	Kamla-Balan	448767
6	Kosi	1141019
7	Mahananda	615006
	TOTAL NORTH BIHAR	5061569
	CENTRAL BIHAR	
8	Genga Stem	
	CENTERL BIHAR	
9	Kammnasa	512688
10	Sone(Stem)-Kanhar & Kao-Gungi	937471
11	Punpun	502575
12	Harohar	1429918
13	Kiul	292732
14	Badua-Belharna	221500
15	Bilasi-Chandan-Chir	409305
	TOTAL CENTERL BIHAR	4705889
	SOUTH BIHAR	
16	Gumani & Koa-Bhena	428608
17	Mayurakshi & Others	571218
18	Ajay	355365
19	Sankh	402743
20	South Koel	1058856
21	North Koel	1057436
22	Barakar	702600
23	Damodar	990780
24	Kharkai	420602
25	Subernarekha	859146
26	Small Streams Draining Independently Outside The State	168468
	TOTAL SOUTH BIHAR	7015822
	GRAND TOTAL	17330607

RIVER BASIN / SUB-BASINS IN BIHAR STATE

Sl No	Name of main river/rivers	Allotted basin number	Outfall of the main river
1	Ghoghra	i	Ganga
2	Gandak	2	Ganga
3	Burhi Gandak	3	Ganga
4	Bagmati-Adhwara	4	Kosi
5	Kamla-Balan	5	Kosi
6	Kosi	6	Ganga
7	Mahananda	7	Ganga
8	Ganga-Stem	14	Bay of Bengal
9	Kao-Gangi etc	14A	Ganga
10	Baya	14B	Ganga
11	Koa-Bhena etc	14C	Ganga
12	Mahi	14D	Ganga
13	Kamnasa	8	Ganga
14	Sone(Stem)	9	Ganga
15	Kanhar	9A	Sone
16	North Koel	9B	Sone
17	Punpun	10	Ganga
18	Kiul	11	Ganga
19	Harohar	11A	Kiul
20	Badua-Belharna	12	Ganga
21	Chandan-Bilasi-Chir	13	Ganga
22	Gumani	15	Ganga
23	Mayurakshi and other adjoining streams	16	Bhagirathi
24	Small Streams Draining Independently outside the state	16A	Brahmani
25	Ajay	17	Bhagirathi
26	Sankh	18	South Koel
27	South Koel	19	Brahmani
28	Damodar	20	Bhagirathi
29	Barakar	20A	Damodar
30	Subernarekha	21	Bay of Bengal
31	Kharkai	21A	Subernrekha

These 31 basins/sub-basins have been regrouped into 26 composite basins taking into consideration the inter basin of water

SECOND BIHAR STATE IRRIGATION COMMISSION

प्रेषकः श्री जगदानन्द
मंत्री,
जल संसाधन विभाग, बिहार
—सह—
अध्यक्ष,
द्वितीय बिहार राज्य सिंचाई आयोग

पटना, दिनांक 30 अगस्त, 94

अर्द्ध सरकारी पत्रांक – 448

आदरणीय मुख्य मंत्री जी,

आप अवगत हैं कि राज्य सरकार ने वर्ष 1991 में द्वितीय बिहार राज्य सिंचाई आयोग का निर्णय लिया था। जल संसाधन विभाग के पत्रांक 268 दिनांक 15.2.1991 द्वारा उक्त आयोग के गठन को अधिसूचित करने के साथ कार्यारम्भ हुआ। पूर्णकालीन सदस्यों, पदेन सदस्यों एवं अंशकालीन सदस्यों की समभागिता में अनुभवी अभियंताओं, अर्थशास्त्री, कृषि विज्ञान संकाय के प्रतिनिधियों के साथ–साथ किसान प्रतिनिधि को भी आयोग के सदस्य के रूप में मनोनीत किया गया था। समय–समय पर विशेषज्ञों को विचार विमर्श में सम्मिलित किया गया या उनकी सेवायें ली गयी।

राज्य सरकार ने वर्ष 1967 में प्रथम बिहार राज्य सिंचाई आयोग का गठन किया था, जिसकी संस्तुतियां वर्ष 1971 में प्राप्त हुई थी। उक्त आयोग की अनुशंसाओं के कई अंश विभाग ने अपनी कार्य व्यवस्था के द्वारा अनुपालित कराये। परन्तु कई बिन्दुओं पर अनुपालन लम्बित रहे जबकि परिस्थितियों और संदर्भ में बहुत बदलाव हो चुका था तथा कई अनुशसाओं की प्रासंगिकता समाप्त हो गयी थी। प्रथम आयोग की भूमि एवं जल संसाधन के आंकलन की समीक्षा करने और अनुशंसाओं के अनुपालन की अद्यतन स्थिति से सरकार को अवगत होना आवश्यक था ताकि जल संसाधन एवं सिंचाई विस्तार के अनवरत विकास कार्यों को उचित दिशा दी जा सके।

सम्यक विचारोपरांत राज्य सरकार ने द्वितीय बिहार राज्य सिंचाई आयोग को 11 (ग्यारह) विचारणीय बिन्दु (टर्म्स आफ रेफरेंस) दिये थे। प्रथम आयोग के प्रतिवेदन के बाद राज्य की सामाजिक, आर्थिक एवं प्रशासकीय ढांचे में गहान परिवर्तन हुए हैं तथा विकास योजना की रणनीति, राज्य सरकार के साधन–श्रोत, जनसंख्या वृद्धि, भूमि संसाधन की कमी जैसी कई समस्याये पैदा हो गई हैं। राष्ट्रीय जलनीति और राज्य जलनीति की घोषणा की पृष्ठभूमि में सिंचाई विस्तार, बाढ़ प्रबंधन, खाद्य संकट के समाधान, पड़ोसी राज्यों के साथ जल के बंटवारे के एकरारनामे का पुनरावलोकन, राज्यहित के बिन्दुओं की पहचान आदि कई महत्त्वपूर्ण आयाम हैं जिन पर गहन अध्ययन, निष्पक्ष विचार, वैज्ञानिक सुझाव एवं भविष्य की रणनीति को नये सिरे से निरुपित करने की आवश्यकता है। सिंचाई व्यवस्था को आधुनिकता प्रदान करना, सिंचित क्षेत्र की रुपरेखा तैयार करना, सिंचाई योजनाओं को यथा संभव अधिक राजस्व प्रदायी बनाना, संगठनात्मक सुधार, अभियंताओं की दक्षता और कार्य संस्कृति में सुधार जैसे विषयों पर आयोग को विचार करने एवं संस्तुतियां देने हेतु विचारणीय बिन्दु दिये गये थे।

सिंचाई, जल प्रबंधन, बाढ़ नियंत्रण, जल निस्सरण, तटबंध निर्माण, कमांड एरिया विकास अभिकरण आदि पर राज्य में सम्प्रति दस अधिनियम लागू है; जिनके कार्यान्वयन में जनसमूह और सरकार को कठिनाई होती है। भारत सरकार ने सभी राज्यों को नमूनें के अधिनियम का प्रारुप भेजा है जो जल संसाधन से सम्बद्ध है। सभी पुराने अधिनियम सम्मिलित करते हुए एकीकृत अधिनियम बनाने का गुरुत्तर कार्य भी आयोग को सौंपा गया था।

राज्य में पिछली सात पंचवर्षीय योजनाओं की अवधि में सिंचाई की जो योजनायें क्रियान्वित करायी गयी और जिनका कार्यकाल दो–तीन दशक का हो चुका है, उनमें कई योजनाओं के कार्योत्तर मूल्यांकन कराये जा चुके हैं और ऐसे मूल्यांकन प्रतिवेदनों की समीक्षा और अनुपालन बिन्दु चिन्हित करने का भार भी आयोग को था।

द्वितीय आयोग ने सभी 11 बिन्दुओं पर अध्ययन और विचार किया। आयोग की उप समितियों की मदद से, विभागीय अभिलेखों के अध्ययन से तथा प्रश्नावली के माध्यम से सांसदों/विधायकों/मुखियों/जिलाधिकारियों/प्रखण्ड विकास

पदाधिकारियों/पंचायतों से सुझाव मांग कर तथा उन पर विचार कर अनुशंसायें तैयार की गयी हैं। मेरी अध्यक्षता में आयोग की पन्द्रह बैठकें सम्पन्न हुई जिनमें गहन विचार–विमर्श हुए।

आयोग ने राज्य की भूमि और जल संसाधन का विस्तार से अध्ययन कर विभिन्न नदी बेसिनवार विवेचना की है। भूमि और जल की उपलब्धता के आधार पर ही नदी बेसिन योजना का स्वरूप निर्धारित किया गया है, जिसके आधार पर भविष्य में योजनायें चयनित हो सकेंगी। इसी अध्ययन के आधार पर प्रत्येक नदी बेसिन के लिए फसल पद्धति की अनुशंसा की गयी है जो खाद्यान्न उत्पादन के लिए आधार बनेंगी। बाढ एवं जल जमाव के समस्या और निराकरण पर आयोग का प्रतिवेदन राज्य के लिए एक विस्तृत एवं अधिकृत आलेख है जो कई विषयों पर रोशनी डालेगा एवं राज्य को बाढ एवं जल जमाव की समस्याओं से जूझने में मदद करेगा। सिंचाई व्यवस्था को यथासंभव स्ववित्तपोषी बनाने, आय श्रोतों को पहचानने के लिए आयोग ने महत्वपूर्ण सुझाव दिये हैं। राज्य की आधुनिक जल नीति, राज्य के लिए समेकित सिंचाई अधिनियम का प्रारूप और जल संसाधन विभागान्तर्गत अभियंताओं के संवर्ग को पुर्नगठित करने तथा पदधारियों के कर्तव्य एवं कार्यक्षेत्र में संशोधन हेतु सुझाव भी आयोग ने दिया है।

मुझे द्वितीय बिहार राज्य सिंचाई आयोग के सभी 11 विचारणीय बिन्दुओं पर आयोग के निष्कर्ष एवं अनुशंसायें प्रस्तुत करते हुए अपार हर्ष है। अनुशंसायें और नक्शे लेकर पूरा प्रतिवेदन सात खण्डों में संकलित किया गया जो परिशीलनार्थ उपरथापित है। उपरथापित 7 खण्डों में से 5 खंड आयोग के मूल प्रतिवेदन हैं। खण्ड-1 में सभी प्रतिवेदनों के सारांश के साथ–साथ आयोग की कार्यविधि पर सूचना है। वैसे ही खंड-7 मात्र सिंचाई संबंधी मानचित्रों का संग्रह है। खंड-2 से खंड-6 में आयोग की मूल अनुशंसायें संकलित है।

मैं व्यक्तिगत रूप से आपके प्रति आभार व्यक्त करता हूँ कि इस कार्य में आपका मार्ग दर्शन और कृपापूर्ण सहयोग प्राप्त होता रहा। मंत्रिपरिषद के सभी माननीय सदस्य भी धन्यवाद के भागी हैं, जिन्होने आयोग के गठन और स्वीकृति में पूरा सहयोग दिये हैं। मैं सभी सांसदों/विधायकों और मुखियों के प्रति कृतज्ञ हूँ, जिन्होने अपने–अपने सुझाव आयोग को भेजे।

आशा है आयोग की प्राप्त अनुशंसाओं को राज्य सरकार क्रमबद्ध रूप से कार्यान्वित करा सकेगी तथा आयोग के गठन के लक्ष्य प्राप्त हो सकेंगे।

सादर।

भवदीय,

(जगदानन्द)

सेवा में,
माननीय श्री लालू प्रसाद,
मुख्य मंत्री,
बिहार, पटना।

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CONTENTS

VOLUME I

ABBREVIATIONS

AE	Assistant Engineer
A/E	Anti Erosion
AIR	All India Radio
AV	Average
BISCOMAUN	Bihar State Co-operative Marketing Union
BSEB	Bihar State Electricity Board
BHPC	Bihar Hydroelectric Power Corporation
CADA	Command Area Development Authority
CCA	Culturable Command Area
CD	Community Development
CE	Chief Engineer
CEA	Central Electricity Authority
cm	Centimetre
Cusec	Cubic feet per second
Cumec	Cubic metre per second
CWC	Central Water Commission
CWPRS	Central Water and Power Research Station
DCH	District Census Handbook
DL	Danger Level
DPAP	Drought Prone Area Programme
Dr	Doctor
Drg	Drawing
D/S	Downstream
DVC	Damodar Valley Corporation
EE	Executive Engineer
Er	Engineer

FAI	Fertilizer Association of India
Fig	Figure
Ft	Feet
G	Gauge
GCA	Gross Command Area
GD	Gauge and discharge
GDS	Gauge discharge and silt
GDP	Gross domestic product
GFCC	Ganga Flood Control Commission
GOB	Government of Bihar
GOI	Government of India
GW	Ground Water
GWP	Ground Water Potential
ha	Hectare
ham	Hectare metre
HFL	Highest Flood level
HMG	His Majesty's Government
HYV	High Yield Variety
HW	Hot Weather
IMD	Indian Meterological Department.
Irr	Irrigation
ISI	Indian Standard Institution.
ITDP	Integral Tribal Development Project
IWTA	Inland Water Transport Authority
JE	Junior Engineer
Jt secy	Joint Secretary
Km	Kilometre

KMPH	Kilometre per hour
LAF	Lakh acre feet
LAMPS	Large Agricultural Multipurpose society
Lat	Latitude
Lha	Lakh Hectare
LI	Lift Irrigation
Lit	Litre
LMT	Lakh Metric Tonne
Long	Longitude
m	Metre
MAF	Million Acre Feet
Max	Maximum
MCM	Million Cubic Metre
Misc	Miscellaneous
MI	Minor Irrigation
Min	Minimum
mm	Milli metre
MP	Madhya Pradesh
MSL	Mean Sea Level
MT	Metric Tonne
MW	Mega Watt
M&I	Municipal & Industrial
N	North
NA	Not available
NCA	Net Command Area
NDP	National Dometic Product
NE	North East

NERIWALM	North Eastern Regional Institute of Water And Land Mamagement
No	Number
NPK	Nitrogen Phosphate Potash
NWDPRA	National Watershed Development Programme in Rainfed Area
PACS	Primary Agricultureal Co-operative Society
Qtl	Quintal
PWD	Public Works Department
R/M	Repair and maintenance
RF	Reserve forest
Rly	Railway
RM	River Management
Rs	Rupees
Res	Reservoir
R/S	Raising and strengthening
RT&FC	River training & flood control
R	Right
RBA	Rashtriya Barh Ayog
SDO	Sub Divisional Officer
SC	Scheduled caste
Sch	Scheme
SE	Superintending Engineer
SGWO	State Ground Water Directorate
Sl	Serial
Sq Km	Square Kilometre
SRRG	Self Recording Rain Gauge
ST	Scheduled Tribe
SW	Surface Water

TOR	Terms of reference
Temp	Temperature
TAC	Technical Advisory Committee
T&V system	Training & Visit system
TV	Television
U/S	Upstream
UK	United Kinqdom
UP	Uttar Predesh
Veg	Vegetable
Vel	Velocity
WAPCOS	Water and Power Consultancy Service
WQ	Water quality
WRD	Water Resources Department
Wt	Weight
WT	Wireless Transmission
WB	West Bengal
WALMI	Water and Land Management Institute
WMO	Water Meteoroiogical Organisation

INTRODUCTION

The system of irrigation has a hoary past in our State. As early as in 3rd century BC Chanakya emphasised in his famous classic work the "Arthashastra" that the king should construct dams and reservoirs in the region where rain was not sufficient to meet the crop demand. In those olden days population of the country was small and, therefore, food needs of the people also were small. Vast stretches of land were available for cultivation. Forest cover was large and human activities were simple. There was perhaps nothing to disturb the ecological balance and the rainfall pattern etc. Even then, Chanakya felt the necessity of State's intervention for creating irrigational infrastructure in the shape of dams and reservoirs. But those dams and reservoirs were perhaps no better than present day ahars and tanks which were sufficient to provide necessary protection to the crops.

Pynes, ahars and wells were sufficient to meet the irrigation needs of the olden days. But with rise in population, these did not prove sufficient. During floods and famines the smaller population could move out to safer location in the vicinity, which now became impossible with the rise in population and creation of immovable assets with the rise in standard of living. Rise in population continued unabated and the effects of flood and droughts, which were natural phenomena, started appearing as famines at shorter intervals. The then indifference of the State towards creation of additional irrigational facilities and maintenance of existing structures further aggravated the situation. Some famines were very serious bringing catastrophic miseries to the human and cattle population. The land which was more than self-sufficient in food turned into deficient areas because development of irrigation and food production could not keep pace with the rise in population evenly.

By the time the British East India Company took over the responsibility of collecting land revenue from the tenants on behalf of nawabs, the situation had already worsened to a pitiable state. Due to unsettled political situation, bad law and order condition and unsatisfactory fiscal management of the State economy and poor irrigation facilities, the tenants were neither able to grow sufficient crops in their fields nor they were able to pay the land revenue to their new master who appeared in the form of British East India Company. Money in circulation was too meagre. Therefore, commodities were selling quite cheap. A tenant had to sell almost his entire meagre produce to pay the land rent. This was particularly so in the western and middle regions of Central Bihar. The solution appeared to be possible through development of some sort of planned and assured irrigation to increase the crop yield so that the tenant could pay their land rents evenly, side by side, it would naturally go a long way to mitigate the miseries of famines due to more production of foodgrains.

The rule of British East India Company was subsequently replaced by the rule of British India Government under the direct supervision of the British Parliament. It was as late as in the year 1874 that irrigation in a planned manner took shape in this State with the functioning of Sone Canal Project constructed by the then British Government which was initiated by the British East India Company, which provided water to 3.46 Lha of land. A few other projects also came up through Government efforts around the same time, like Teur Canal (1874), Dhaka Canal (1904) and Tribeni Canal (1907). It may be pertinent to note that though these were constructed as a relief measures, criteria for their sanctioning were based on fixed per cent return over the capital after completion of these projects. The Kharagpur Irrigation Scheme was constructed in early seventies of the nineteenth century by the zamindars of the area.

Subsequent to the above and prior to Independence, no major or medium irrigation works worth the name came into being. All the irrigation development works became perhaps the concern of the erstwhila zamindars who had ahars and pynes constructed as well as maintained for benefit of their

tenants. By the end of the last century major and medium irrigation schemes came in, beside the addition of minor irrigation schemes. In spite of these State had to face, most of the times, recurrent famines due to severe droughts.

Naturally, when the era of planning began in 1951 great emphasis was placed on rehabilitation of agriculture with irrigation taking the major slice of planned effort achieving great success. Important projects like Kosi, Gandak, Badua, Chandan and many others were taken up for execution in the earlier Plans. After the completion of Third Plan and three subsequent Annual Plans between 1966-69, the State was able to achieve four-fold increase in irrigation potential from 4.04 Lha in pre-Plan period to 16 Lha through major and medium schemes alone. The combined potential, including 17 Lha of potential created through minor irrigation schemes was 33 Lha. However, the total created potential was only one-fourth of the ultimate irrigation potential. The State had still to go a long way in the direction of creating the full potential and utilise it.

In 1966, worst type of drought in living memory occurred which shook the State and prompted it to take all possible steps to obviate such a situation in future.

Another intriguing situation in the State was recurrent floods which played no less havoc by damaging the crops and other properties as well as human and cattle lives in vast stretch of land, specially in North Bihar. Such floods not only damaged crops and property and brought untold miseries to the people but large low lying areas also got submerged for long duration due to drainage congestion which took a long time to be free from such submergence after the flood receded. The State had to spend a huge sum every year for flood fighting and removal of drainage congestion which severely affected its economy. The situation, therefore, called for elaborate planning and execution of suitable measures to tackle such situations. The severe drought of 1966 in the State was ironically succeeded by severe flood in 1967 which inundated a vast area causing large scale damages. The powers-that-be then realised that the prosperity of the rural areas of the State, where about 86 per cent of the total population lived, depended largely on the proper utilisation of water resources with proper management of flood and removal of drainage congestion through comprehensive planning and execution of such water resources management infrastructures.

First Bihar State Irrigation Commission

In October 1967, the Govt of Bihar set up the First Bihar State Irrigation Commission to cover various aspects of water resources development. The terms of reference of the Commission were as follows:

"(a) To assess as precisely as possible the available water resources of the State, which can be utilised for irrigation and other purposes (such as hydropower, industrial and domestic uses, etc.)

(b) To lay down the policy to be followed to secure proper utilisation and bring about economic exploitation of water resources by different means, i.e., major, medium and minor irrigation works;

(c) To suggest ways and means for conservation of water resources including execution and maintenance of watercourses and field channels, cropping patterns, afforestation, etc, and to consider the problems of waterlogging and drainage;

(d) To review the position in regard to securing maximum financial returns from the existing irrigation projects in the context of making them, as far as practicable, self-financing and while doing so, advise on the existing practice and procedures for recovering water rates, betterment levies, etc;

(e) To examine the administrative and organisational setup generally adopted for planning and execution of irrigation works and suggest ways and means for bringing about improvement in the same;

(f) To review the existing field practice of irrigation with a view to judging as to how they need to be altered so as to be conducive to increase agricultural production from irrigated lands. To appraise the implementation of the Kosi Area Development Programme, and advise if it can be made more effective and to which other areas of the State, and with what modifications, if any, such a programme can be extended; and

(g) Any other matter that may be referred to the Commission by the Govt later."

The Commission made seventytwo recommendations. There is no information available to indicate whether the report and the recommendations of this Commission were formally accepted by the Govt. However, Govt took various actions in the department from time to time since submission of the report for better utilisation of the water resources of the State and for improving the managerial efficiency of the department even though without making any reference to the said recommendations. The important recommendations which do not seem to have been acted upon by Govt were eighteen in number.

The comments of Second Bihar State Irrigation Commission on the recommendations of First Bihar State Irrigation Commission and guidelines for their implementation were submitted to Govt under Commission's letter no 22 dated 28.1.92. This is incorporated as Appendix 1.

Development After Seventies

Submission of the report by the First Bihar State Irrigation Commission was followed by many reports of the National bodies, viz, report of the Second Indian Irrigation Commission (1972), report of National Commission on Agriculture (1976) and report of the Rashtriya Barh Ayog (1980). These reports contained wide ranging recommendations. These recommendations covered policy imperatives on national and regional issues concerning land and water development and management. These also emphasised the need for preparation of comprehensive river basin plans and for treating the flood protection measures as a component of the water resources development programme.

In 1984, the National Water Resources Council was appointed under the Chairmanship of the Prime Minister and the National Water Policy was declared in 1987 in which, inter alia, stress was placed on:

(a) maximisation of water resources availability through planning for drainage basin as a whole or for a sub-basin,

(b) multi-disciplinary approach to planning including the ecological aspects,

(c) establishment of an appropriate organisation for planned development and management of river basin as a whole,

(d) establishment of a standardised information system and data bank,

(e) close integration of water use and land use policies, and

(f) rationalisation of water rate with due regard to the interests of small and marginal farmers etc.

Water allocation priorities had also been indicated in this document.

The Reserve Bank of India also published the Sen Committee report in the year 1984 on agricultural productivity in eastern region.

Since the publication of the report of the First Bihar State Irrigation Commission, there have taken place other important developments as well, such as signing of interstate agreements on sharing and

use of water by the co-basin states, setting up of agencies/authorities/corporations for regional development, tribal welfare, drought prone areas programme and hydropower development etc Command Area Development Agencies have also been created with the major objective of bridging the gap between potential created and utilised. From time to time, various conferences of the Irrigation Ministers of the states have also put forward valuable recommendations on important issues of operation and maintenance of the irrigation projects, water rates, priorities in planned development and so on.

Myriads of hydrometeorological data based on modern meteorological studies have been supplemented by various agencies since then and the land use pattern has undergone drastic changes under the impact of various developmental works, such as construction of dams, reservoirs, roads, embankments, establishment of industries, growth of towns and market places and so forth. There has been a sea-change in the landscape all around. By the end of the Seventh Plan the development of irrigation potential in the State cumulatively increased to 50.91 Lha (27.15 Lha through major and medium and 23.76 Lha through minor irrigation schemes) as against about 33 Lha (16 Lha and 17 Lha respectively). On the other hand, foodgrains production increased to 122.6 Lakh MT in 1991 as against 83.5 Lakh MT in 1971, at the time of publication of the First Commission's report. Not withstanding this, the State continued to remain a food deficit one. This triggered off the whole gamut of issues pertaining to the ultimate irrigation potential, increase of crop yield by on-farm development works like provision of infrastructural facilities, drainage, flood management, etc, which needed a fresh look so that the State economy had a face lift. The mere expansion of irrigation potential, however, did not act as a panacea for all ills from which the State suffered, such as low productivity, poverty and regional imbalances. The State Govt got post-facto evaluation studies of over a dozen completed irrigation projects conducted. This revealed a list of structural and non-structural deficiencies in the existing projects. It was found necessary to increase the efficiency and effectiveness of the projects. On the one hand, the State had to go a long way in achieving the ultimate potential and on the other, more effective steps had to be taken to utilise the created potential for accelerating the yield rate of 27.15 Lha of the land which benefited from the major and medium schemes. The annual assessment of irrigated area revealed that actual irrigation was provided in 14 Lha only. Not only that, even the cost incurred on assessment of water rates from the beneficiaries far exceeded the revenue collected. In case of minor irrigation schemes practically no realisation or even assessment of water rate was made from beneficiaries.

SECOND BIHAR STATE IRRIGATION COMMISSION

By the end of the eighties, urgent necessity was felt for planning the water resource development, its management and working out solution to flood and drainage problems on basinwise concept after reviewing and updating the assessment of land and water potential. It was also necessary to review the policy and programme of water resources development and management in the light of the National Water Policy. The new trends in the field of water management and other developments called for strengthening and streamlining the organisational setup to face the future challenges. Rationalisation of water rates, amalgamation of various Acts concerning irrigation/flood control/drainage improvement and review of the interstate agreements were also the pressing needs of the department. In this context, with a view to have an in-depth study of the aforesaid problems encountered by the State Govt and to effect an improvement in the prevailing situation, the Second Bihar State Irrigation Commission was setup by the State Govt, vide WRD letter no 1/PMC/N/60/86-268 dated 15.2.91 (Appendix IIA) and Resolution no 829 dated 6.3.91 (Appendix IIB).

The panel of the members of the Commission was constituted as under:

Chairman

1 Minister, Water Resources Department, Govt of Bihar

Full Time Members

2 Water Resources Development Specialist (in the rank of Engineer-in-Chief)
3 Water Management Specialist (in the rank of Chief Engineer)
4 Flood Management Specialist (in the rank of Engineer-in-Chief)
5 Economist (in the rank of Chief Engineer)
6 Agriculture Specialist (in the rank of Chief Engineer)

Part Time Members

7 Member (Water Planning), Central Water Commission, GOI
8 Agriculture Production Commissioner, Bihar
9 Rural Development Commissioner, Bihar
10 Land Reforms Commissioner, Bihar
11 Commissioner and Secretary, Water Resources Department, Bihar
12 Commissioner and Secretary, Energy Department, Bihar
13 Secretary, Forest and Environment, Bihar
14 Engineer-in-Chief, Water Resources Department, South Bihar
15 Engineer-in-Chief, Water Resources Department, Central Bihar
16 Engineer-in-Chief, Water Resources Department, North Bihar
17 One representative of Consumers
18 One representative of Social Service Organisations
19 Director, Anugrah Narain Sinha Institute of Social Studies, Patna, or his representative
20 Director, Centre for Water Resources Studies, Bihar College of Engineering, Patna University, Patna.

It was stipulated in the aforesaid Govt order that one of the full-time Members would act as Member Secretary to the Commission.

Terms of Reference

The terms of reference (TOR) of the Commission were as given below. The English version of the TOR is also given within parentheses.

1 राष्ट्रीय जल नीति में दिए गये प्रावधानों के आलोक में राज्य के जल संसाधन विकास एवं प्रबंधन की वर्तमान नीतियों एवं कार्यक्रमों की समीक्षा करना। राज्य के सूखा एवं बाढ़ की समस्याओं, सामाजिक आर्थिक पिछड़ापन, क्षेत्रीय विषमताओं आदि के संदर्भ में सिंचाई, पेय जल, उद्योग एवं जल विद्युत उत्पादन, औद्योगिक एवं अन्य कार्यों, में जल के उपयोग को ध्यान में रखते हुए उपयुक्त सुधार एवं सुझाव देना।

(To review the present policies and programmes of water resources development and management in the light of provisions of National Water Policy and to suggest measures for improvement in the light of the State's problems of drought and flood, socio-economic backwardness and regional imbalances, keeping in mind the use of water for irrigation, drinking, industry and hydropower generation besides its other uses.)

2 पूर्ववर्ती सिंचाई आयोग द्वारा प्रत्येक बेसिन/उपबेसिन में जल एवं भूमि संसाधनों के मूल्यांकन की समीक्षा करना एवं उसको अद्यतन करना। प्रचालन एवं कार्यान्वयन के अधीन योजनाओं के माध्यम से उपयोग के वर्तमान स्तर को निर्धारित करना एवं उपलब्ध संसाधनों के सीमान्त या लगभग सीमान्त रक्षा के लिए तकनीकी विकल्पों के साथ अधिकतम संसाधनों को निर्धारित करना।

(To review the basinwise evaluation of water and land resources as done by the previous Irrigation Commission and to update it. To ascertain the present level of utilisation of the water resources through the projects under operation and execution and to determine the maximum level of available resources with suggestions for technological alternatives for the optimum or near optimum utilisation of resources.)

3 सह बेसिन राज्यों के साथ राज्य सरकार द्वारा किए गये सभी अन्तर्राज्यीय एकरारनामों के प्रावधानों की समीक्षा करना एवं जल संसाधनों के विकास एवं प्रबंधन से सम्बन्धित राष्ट्रीय लक्ष्यों एवं उद्देश्यों के समग्र ढांचे के भीतर राज्य के हितों की रक्षा एवं भविष्य के लिए नीति निर्धारण के बारे में परामर्श देना।

(To review the provisions of interstate agreements with co-basin states and to advice for safeguard the interests of the State and for future policy determination within the overall national frame-work of aims and objectives concerning the development and management of water resources.)

4 प्रमुख नदी बेसिनों के लिए जल संसाधनों के विकास एवं प्रबंधन की सर्वांगीण योजना की रूप-रेखा तैयार करना, टाल की संसाधन क्षमता के अनुरूप कार्यक्रम के अनुसार परियोजनाओं के विस्तृत आयोजन एवं कार्यान्वयन के लिए प्राथमिकताओं के निर्धारण के बारे में सुझाव देना।

(To prepare outlines of unified plans for development and management of water resources of major river basins and to make suggestions for fixing priorities for detailed planning and execution of the Tal area schemes according to their water resources potential.)

5 वर्तमान संगठनात्मक, वैधिक एवं कार्यपालक, प्रचालन एवं अनुरक्षण एवं जल प्रबंधन के साथ साथ अंतर्विभागीय समन्वय पक्षों की जांच करना एवं वर्तमान व्यवस्थाओं को मजबूत करने तथा उन्हें सुनियोजित (स्ट्रीमलाईनिंग) करने के लिए उपयुक्त अनुशंसायें करना ताकि जल संसाधनों के विकास, सिंचाई प्रबंधन एवं बाढ़ नियंत्रण/सुरक्षा की नई चुनौतियों का सामना राज्य कर सके।

(To examine the present organisational, legal and executive provisions for maintenance, operation and water management, including inter-departmental co-ordination and to make necessary recommendations for strengthening and streamlining them to face future challenges in development of

water resources, irrigation and flood protection/control.)

6 पूरी की गई नदी वेसिन परियोजनाओं के कार्योत्तर प्रतिवेदनों का अध्ययन करना एवं राज्य में वर्तमान परियोजनाओं की कार्यक्षमता एवं प्रभावशीलता को बढ़ाने के लिए उपयुक्त उपायों की अनुशंसा करना।

(To study post-facto evaluation reports of the completed irrigation projects and to suggest necessary measures to increase the efficiency and effectiveness of the present projects.)

7 विभिन्न अधिनियमों, उनके अधीन तैयार किए गये नियमों, अध्यादेशों एवं कार्यपालक आदेशों के साथ–साथ भारत सरकार के विधि आयोग द्वारा सुझाये गये आदर्श सिंचाई संहिता का परीक्षण करना एवं राज्य के भीतर की कृषि एवं सामाजिक आर्थिक परिस्थितियों के अनुरूप आदर्श सिंचाई संहिता का प्रारूप तैयार करना, जिसका उद्देश्य जल संसाधन विकास परियोजनाओं, सिंचाई प्रबंधन, जलकरों के मूल्यांकन एवं वसूली, अभिलेखों के अनुरक्षण इत्यादि के कार्यान्वयन के लिए कई अधिनियमों में विहित वर्त्तमान नियमों, प्रणालियों एवं प्रक्रियाओं का रेखांकन हो।

(To prepare a draft Model Irrigation Manual suited to the agricultural and socio-economic situations of the State after examination of the various Acts, Rules etc, framed under these Acts, Ordinances, Executive Orders and the Model Irrigation Manual framed by the Law Commission of Govt of India with a view to ensuring satisfactory irrigation management, water rate assessment and collection and proper record keeping.)

8 राज्य में बाढ़ एवं जल जमाव की समस्याओं का गहराई से अध्ययन करना – विशेषकर उत्तर बिहार जो नदियों से बहुत बुरी तरह प्रभावित रहता है, के बाढ़ के लिए सहघाटी राष्ट्र के जल ग्रहण क्षेत्रों के प्रबंधन एवं बाढ़ नियंत्रण/सुरक्षा तथा जल निकास में सुधार के लिए दीर्घकालीन एवं अल्पकालीन उपायों की अनुशंसा करना।

(To study in-depth the problems of flood and waterlogging in the State, specially in North Bihar and to suggest long term and short term measures for management of catchment area in the co-basin countries for flood control protection and drainage.)

9 बाढ़ नियंत्रण एवं जल निस्सरण विकास सहित जल संसाधनों के विकास एवं प्रबंधन से सम्बन्धित किसी अन्य मामले का परीक्षण एवं उपयुक्त उपायों का सुझाव देना और कोई भी अन्य मामला जिसे राज्य सरकार द्वारा आयोग को निर्दिष्ट किया जाए।

(To examine and suggest measures on any other matter relating to flood control and drainage, development and management of water resources and any other matter referred to the Commission by the State Govt.)

10 योजनाओं के रख–रखाव को सेल्फ फाईनान्सिंग बनाने के लिए सिस्टम मैनेजमेन्ट की व्यवस्था लागू करने हेतु प्रतिवेदन तैयार करना।

(To prepare a report to introduce system management to make maintenance of the projects self-financing.)

11 सिंचाई के आधार पर राज्य को प्रत्यक्ष या परोक्ष रूप से अधिक प्रभावकारी रूप से आमदनी के स्वरूप का अध्ययन कर प्रतिवेदन देना।

(To study and report on the structure of direct and indirect revenue based on irrigation for more effective income to the Stat)

During the tenure of the Commission no other reference was made to the Commission by the Govt for its consideration.

Tenure of the Commission

Initially the tenure of the Commission was for two years and it was expected that it would submit its report by February 1993. But a host of factors, e.g., delay in the appointment of Members, the long drawn strike by the Engineers and also a strike of the non-gazetted employees of the State delaying the commencement of the actual working of the Commission until January 1992, involvement of multidisciplinary parts in the volume of work, delay in collection of information from various sources and organisations, etc, necessitated extension of the tenure of the Commission which was effected in the following phases:

(a) From 1.3.93 to 28.2.94 vide notification no 1038 dated 6.3.93 of Water Resources Department.

(b) From 1.3.94 to 30.4.94 vide notification no 654 dated 25.2.94 of Water Resources Department.

(c) From 1.5.94 to 31.8.94, notification awaited.

Appointment of Members/Experts

The Commission started functioning no sooner than Director, WALMI, Bihar Sri R S Sinha was appointed acting Member Secretary of the Commission in the month of May 1991. Prof C P Sinha (Member, Water Management) took over as regular Member Secretary in the month of August 1991. Of other full-time Members, Sri G P Shahi (Member, Water Resources Development) joined on 1.8.1991, Sri G S Singh (Member, Flood Management) on 30.8.1991 and Dr K N Prasad (Member, Economics) on 5.8.1991. Sri Nitish Kumar MP and Sri Saryu Rai were also notified as part-time Members of the Commission in their capacities as representatives of the consumers and the social service organisations respectively.

On receiving an assignment as Director, NERIWALM, GOI Prof C P Sinha left the Commission on 30.10.1992. Sri V B Bhagat succeeded Prof Sinha as Member Secretary with effect from 30.10.1992. The post of Member, Agriculture, remained vacant for long as none of the two officers belonging to the Agriculture Faculty notified in succession joined. However, on the third notification Sri J Ram of the Bihar Agriculture Service joined in November 1993. The Commission had to seek the expert advice or regular services of a few specialists in the formulation of ideas and views incorporated in the various reports of the Commission. Notable among them, we had Sri S N Singh, Retired Joint Director, Agriculture and a former consultant of Agricultural Finance Corporation, Patna as an agriculture expert, Sri R B Sharma, Retired Engineer-in-Chief, who helped the Commission as expert on legal provisions and Sri D N Mehta, Retired Supering tending Engineer, WRD, Bihar who acted as a basin planning expert. The Commission had the benefit of valuable suggestions from two enlightened public representatives namely Sri Badri Singh and Sri Nagendra Prasad Singh (both ex-MLAs) who were inducted in the Working Group of the Sub-committee-1.

Several permanent invitees and special invitees to the regular meetings of the Commission and its Sub-committees were also inducted from time to time (Appendix III) to suggest guidelines and tender advice on the various issues.

Personnel Attached to the Commission

To render necessary assistance to Members of the Commission in such tasks as collection of publications, documents, statistical data and reports from the Govt departments and organisations and in studies and preparation of reports, personnel belonging to the Master Planning and Design Circle-3 with its two Divisions (Master Planning and Design Divisions-7 and 8) having 15 Assistant Engineers were administratively placed under the Commission with its Member Secretary as the controlling officer. Services of two Assistant Engineers from Design wing of WRD were also made available to the Commission on deputation. Sri R R P Sharma, SE Flood Control and Design Circle, Patna alongwith

his Executive Engineer Sri T N Srivastava and Sri Gagan Prasad, SE Monitoring Circle-5 with his Executive Engineer, Sri R R Prasad were also attached to work with the Commission in addition to their own duties. Later, Sri Tapas Kumar Sinha, Executive Engineer, Planning and Monitoring Circle 1, Patna joined the team to work on basin planning in addition to his own duties. The Assistant Engineers, Junior Engineers and ministerial staff of the attached Circle and Divisions discharged technical and ministerial assistance to the Commission. A list of such personnel is enclosed as Appendix IV. Commission had its office located in the rented apartment of Biscomaun Tower Complex at Patna.

Sub-committees/Working Groups/Teams

In compliance with the decision taken at the first meeting of the Commission five Sub-committees were constituted for undertaking studies for preparing draft reports in the light of the different TORs as follows:

Sub-committee	Chairman of the Sub-committee	TOR allotted
1	Sri Saryu Rai	1 and 3
2	Sri G P Shahi	2, 4 and 6
3	Commissioner & Secretary, WRD	5 and 7
4	Sri G S Singh	8 and 9
5	Dr K N Prasad	10 and 11

Member Secretary to the Commission was Convener of each Sub-committee. The list of members of these Sub-committees is available at Appendix V. A few working groups were also formed to help these Sub-committees. These are also listed in Appendix V. Attempts were made to appoint Nodal Officers for each district of the State to help the Commission in collection of specified data. Although a directive on the subject was issued by Chief Secretary, Bihar, to all district officers and Nodal Officers were appointed in some cases, yet no tangible work was done by them owing to implicit difficulties.

Considering the necessity of detailed information for preparing an integrated plan for the development and management of the water resources of the major river basins, four teams of Engineers were formed (Appendix VI) for preparation of basin plans for four major Command Areas of the Gandak, Kosi, Sone and Subernarekha projects. Their contribution were of much help to the commission.

Questionnaires

Immediately after resumption of their normal duties by the Engineers in January 1992, pre-structured questionnaires were circulated to the various departments of the Govt of Bihar to elicit information and opinion on matters relating to the subject matters of the different TORs. Besides the concerned departments of the State Govt, questionnaires were also circulated to different universities of Bihar, Command Area Development Agencies, Indian Meteorological Department, Central Water Commission, Central Ground Water Board, etc seeking the necessary information from them.

Questionnaires pertaining to floods were issued to the Railways, Ganga Flood Control Commission, Central Water and Power Research Station, Pune, Irrigation Research Institute, Khagaul, etc also in order to get the benefit of their valuable opinions and suggestions. MPs, MLAs and MLCs of the State were requested to spell out problems of their respective constituencies through separate questionnaires forwarded to them.

Apart from these, some retired Engineers of the State were approached with separate sets of questionnaires and were requested to express in writing their views as well as suggestions on the subjects with which they had been associated in the State, when in active service. Another questionnaire

on the problems of the Tal area was circulated to the MPs, MLAs, MLCs, mukhias and sarpanchs of the area. All the Block Development Officers of the State were requested to send information to the Commission on the irrigation schemes they considered possible in their respective areas. The District Officers were requested to communicate to the Commission problems faced by their respective areas with regard to land and water use. The response from the various organisations and individuals and officers was, by and large, positive. The outcome was wide ranging information and suggestions received by the Commission which proved valuable for the Commission's report. Problems besetting diverse locations scattered over remote basins have found their due place in the Commission's report because of this extensive response.

Meetings of the Commission

The first and second meetings of the Commission were held in the campus of the WALMI on 6.5.91 and 3.6.91 respectively at which detailed discussions regarding nomination of Members and formation of Sub-committees were held, besides working out the infrastructural shape of the Commission essential for its functioning. The third meeting of the Commission was held on 26.6.91 in its own office at which a detailed write-up on the recommendations of the First Bihar State Irrigation Commission and the follow up action was launched, as well as the validity and relevance of those of its recommendations which could not be implemented in the present context, was presented. In this meeting it was also decided to organise a seminar to discuss threadbare the TORs of the Commission and to prepare the design and format of the questionnaires for collecting the desired information from the various organisations. The seminar was held on 20.7.91. The discussions focussed on the terms of reference of the Commission and the methodology to be adopted for collecting views, opinions and suggestions from people in different walks of life.

The fourth meeting of Commission was held on 14.1.92 after a long interval due to the strikes by the Engineers and the non-gazetted staff. In this meeting, discussions were held on recommendations of the First Bihar State Irrigation Commission, draft basin map, recommendations of the workshop on TORs and miscellaneous matters. Presentation and discussion on the reports against various TORs began in the fifth meeting of the Commission held on 9.4.92 in which part reports on some of the TORs were placed. Thereafter the Commission held ten more meetings, one after another, of which the fourteenth meeting had eight sittings on single agenda. The last meeting of the Commission was held on 17.8.94. All the meetings were presided over by Sri Jagdanand, Minister, Water Resources and Tourism, Govt of Bihar and Chairman of the Commission.

The matters/reports as presented and discussed in the various meetings of the Commission are listed below:

Sl no	Meeting no	Date	Matters/Reports
1	1st	6.5.91	Nomination of Members and methodology for collection of data etc
2	2nd	3.6.91	Infrastructural developments, formation of Sub-committees etc
3	3rd	26.6.91	Recommendations of First Bihar State Irrigation Commission, formation of Sub-committees
4	4th	14.1.92	Recommendations of First Bihar State Irrigation Commission, Recommendations of the Seminar on TOR of Second Bihar State Irrigation Commission
5	5th	9.4.92	i Report on interstate agreements (Bansagar, Rihand, Kanhar and Moosakhand) ii Satta system iii Water availability of Sone basin

			iv	Rules of Business of the Commission
6	6th	18.7.92	i	Water availability of Ajay basin
			ii	Report on interstate agreements (Subernarekha, Gandak and Kosi)
			iii	Comments on evaluation studies of projects by consultants (Kamla & Lower Morhar projects)
7	7th	26.8.92	i	Report on interstate agreements (Moosakhand, Ajay, Mayurakshi-Sidheshwari-Noonbheel, Mahananda and Damodar-Barakar)
			ii	Comments on evaluation studies (Lower Kiul, Upper Morhar and Sakri projects)
8	8th	8.10.92	i	Water Availability of Kosi basin
			ii	Comments on evaluation studies (Badua, Palana, Paras, Gowai, Kohira, Moosakhand and Mayurakshi projects)
			iii	Flood plane zoning
			iv	Report on Tal area schemes
9	9th	18.12.92	i	Report on flood and drainage problems in Gandak basin
			ii	Comments on evaluation studies (Uria-Danro, Chandan, Sone high level, Kanchi and Durgawati projects)
			iii	Report on water availability (Punpun, Burhi Gandak, Bagmati and Kamla)
10	10th	29.03.93	i	Report on land potential of the State
			ii	Report on water availability in Badua-Belharna and Bilasi-Chandan-Chir basins
			iii	Report on status of land and water resources in Ajay basin
			iv	Report on flood and drainage problems in Kiul-Harohar basin
11	11th	25.6.93	i	Report on water availability (Gandak, Mayurakshi and Damodar-Barakar)
			ii	Report on status of land and water resources (Punpun, Badua-Belharna and Bilasi-Chandan-Chir)
			iii	Report on flood and drainage problems in Burhi-Gandak and Kosi basins
			iv	Report on structure of direct and indirect revenues based on irrigation
12	12th	1.10.93	i	Report on water availability (11 basins)
			ii	Report on status of land and water resources (17 basins)
			iii	Report on outline of unified plan for development and management of land and water potential of Punpun basin
			iv	Water rates (TOR 10 and 11)
			v	Report on flood and drainage problems in Mahananda, Kamla, Bagmati and Ghaghra basins
13	13th	18.01.94	i	Report on outline of unified plan for development and management of land and water resources (11 basins)
			ii	Report on flood and drainage problems in Punpun, Sone and Ganga Stem basins
			iii	Draft of Model Irrigation Act
14	14th	25.2.94 (continued on 28.2.94,	i	Report on outline of unified plan for development and management of land and water resources (13 basins)
			ii	Report on outline of unified plan for development and

	8.3.94, 6.4.94, 13.4.94, 26.4.94 and 30.6.94)		management of land and water resources of the State iii Report on streamlining of the organisational structure iv Report on flood and drainage problems of the Bihar State
15	15th	17.8.94	i Finalisation of report on TOR (Final) 10 and 11 ii Summary of findings and recommendation iii Signature of Members.

Field Visits

Study of various issues by the Commission went hand in glove with certain field visits by panels of Members arranged to acquire latest and first hand information on various aspects thereof by combining with as many persons of the various disciplines as possible at different places. Firstly, the Tal area from Fatuha to Singhaul was visited and interaction with people of the locality was organised to ascertain problems of the area and the expectations of the people inhabitating it. The possible sites of the link channels between Mokama Group of Tals and the Ganga were examined and the expected benefits through various possible measures were assessed. Similar visits were made by the team of the Commission to Aurangabad, Palamu, Rohtas and Bhojpur areas to go into the location-specific situations on various projects and to exchange views with a cross section of the people and the Engineers of the respective areas after holding discussion with them on a variety of problems facing their areas. A similar visit was made to Muzaffarpur as well, where discussion was held at length with a band of Engineers working in the Ghaghra, Gandak, Burhi Gandak and Bagmati river basins in the presence of Chairman, Gandak Command Area Development Authority. Another panel of experts of the Commission visited some of the completed projects in Santhal Pargana, Munger and Bhagalpur regions to explore possibilities of the mechanism for increasing the efficiency and effectiveness of the existing projects besides various other matters engaging the attention of the Commission.

Miscellaneous Issues in Functioning of the Commission

The working of the Commission received severe jolts due to one of the posts of its two key functionaries, i.e. of the Member Secretary and the Superintending Engineer of the Circle attached to the Commission, lying vacant for months as Sri V B Bhagat, had to function both as Superintending Engineer incharge of the Circle attached to the Commission as well as the Member Secretary after Prof C P Sinha, Member Secretary, left the Commission by the end of October 92 on getting an assignment as Director, NERIWALM, Govt of India. In February 93, Sri Bhagat was promoted to the rank of Chief Engineer and was given an independent charge of the office/post of the Member Secretary. Further setback was caused due to frequent changes in the incumbancy of the post of Superintending Engineer. The post of SE was filled up by Sri Shashi Shekhar Singh in February 93 but he also the Commission on 27.10.93 on getting assignment in Planning Commission, Govt of India. Sri Gagan Prasad thereafter joined as Superintending Engineer incharge in addition to his own duties. On 18.11.93 Sri Satya Pal Soni replaced Sri Prasad by another notification but Sri Soni retired soon on 31.12.93. In the last phase Sri Md Ahmad joined as Superintending Engineer on 27.1.94. He, however, was burdened with the additional charge of the posts of Chief Engineer, Advance Planning and Chief Engineer, Design in WRD. But for the part time support of Sri Ram Ratan Prasad, Sri Tapas Kumar Sinha and Sri T N Srivastava, Executive Engineers, the work would have suffered a further setback.

The endemic financial crunch suffered by the Govt and the consequential restraints on normal expenditures imposed by it came in the way of the smooth functioning of the Commission throughout its life impairing its efficiency and productivity in a multitude of ways e.g. working of photocopier and computers without UPS and generator, non-repair of vehicles, non-payment of telephone and electricity bills, house rent of the office and honorarium to members and experts. As the report of the Commission was processed through computers, frequent power failures played havoc, sometimes disastrously jeopardising the work.

Submission of Interim Reports

The reports on various TORs finally approved by the Commission were prepared in numerous copies and in instalments submitted to the Govt. But these reports were considered interim for the reason that the Govt might refer them back to the Commission to review or reconsider some of its recommendations. However, nothing of the sort happened and hence the interim reports are considered the Commission's final report.

The first report of the Commission was submitted to the Govt of Bihar on 28.1.92. It concerned the status of implementation of the recommendations of the First Bihar State Irrigation Commission.

The report on the interstate agreements (TOR 3) was approved by the Commission in its seventh meeting held on 26.8.92 and on being examined thereafter by an Expert Committee constituted by the Commission, it was submitted to the Govt on 2.10.92. The report on TOR 1 concerning the policies and programmes of water resources development and management was submitted to the Govt on 23.10.92 after getting it examined by another Expert Committee, constituted by the Commission. Three reports viz, one on the Satta System, the second on Flood Plain Zoning and the third on Prioritization of Tal Area Schemes were submitted to the Govt on 3.12.92. The report on TOR 6 concerning suggestions for increasing the efficiency and effectiveness of the existing projects was submitted on 1.3.93.

The basinwise reports on TOR 2, 4 and 8, reports on the financial aspects (TOR 10/11), Acts and Rules (TOR 7) and organisational matters (TOR 5) were discussed at length in the sixth to thirteenth meetings, besides numerous sittings of the fourteenth meeting and the last meeting of the Commission on 17.8.94. Report pertaining to TOR 8 was submitted to the Govt on 6.7.94, that pertaining to TOR 2 on 18.7.94 and to TOR 4, 5 & 7 on 10.8.94. The report on TOR 10 and 11 which was finally discussed in the last meeting of the Commission was submitted to the Govt by the end of August 1994.

The Final Report

The interim reports submitted in phases drew no references for reconsideration or modifications. Final report was decided to be published in seven separate volumes after regrouping the individual reports for facility in printing and usage thereafter. Volume I of the final report contains the report on objectives and activities of the Commission and summary of important findings and recommendations. It also contains the guidelines for implementation of the recommendations of First Bihar State Irrigation Commission. Volume II of the report deals with the assessment of land and water resources, their present uses and future demands in 26 composite basins. Volume III gives the basinwise outlines of the unified plans for development and management of land and water resources of the State, report on Satta system and suggestions for fixing priorities for planning and execution of the Tal area schemes. Volume IV of the report contains the studies on post-facto evaluation reports of seventeen projects got conducted by the GOB and suggestions on necessary measures for increasing the efficiency and effectiveness of the existing irrigation projects. Volume V contains report on an approach to the problems of flood and drainage congestion and their remedial measures in Bihar as a whole and for the flood prone river basins of the State which are eleven in number. Volume VI contains the Commission's report on six terms of reference viz number 1,3,5,7,10 and 11. These reports pertain to policies and programmes of water resources development and management, review and suggestions on interstate agreements, recommendations for streamlining the organisational structures, Draft Irrigation Act, introduction of system management for self-financing of projects and structure of direct and indirect revenues based on irrigation.

A set of maps has been prepared showing irrigation and flood control and drainage schemes and other details in one sheet and soil characteristics on another sheet, separately for each basin. The set of maps is presented in the form of Atlas in Volume VII.

List of the Volumes

Volume no		Subject	Related TOR
I		Objectives and activities of the Commission and summary of important findings and recommendations	Consolidated
II		Basinwise assessment of land & water resources of the State and present status of utilisation	TOR 2
III		Outline of development and management of water resources of different river basins of Bihar	TOR 4
IV		Measures for increasing the efficiency and effectiveness of present projects	TOR 6
V	Part I & II	Flood and drainage problems of Bihar and their remedial measures	TOR 8
VI	Part I	Policies and programme of water resources development and management	TOR 1
	Part II	Review of interstate agreements and suggestions	TOR 3
	Part III	Streamlining of organisational structure	TOR 5
	Part IV	Draft Irrigation Act	TOR 7
	Part V	Introduction of system management for self-financing of projects	TOR 10
	Part VI	Structure of direct and indirect revenues	TOR 11
VII		Maps of river basins and soil resources	

SUMMARY OF IMPORTANT FINDINGS AND RECOMMENDATIONS

The main findings and recommendations under different topical issues are presented in subsequent paragraphs. These findings and recommendations are extracted from detailed reports relating to different Terms of Reference contained in various volumes.

VOLUME II

BASINWISE ASSESSMENT OF LAND AND WATER RESOURCES OF THE STATE AND PRESENT STATUS OF UTILISATION (TOR 2)

Findings

The report on TOR 2 is a status report on land and water resources of the State and their present utilisation. The salient features are summerised as below:

The State of Bihar, the ninth largest in size in the country, lies between latitudes 21°58'10" N and 27°31'15" N and longitudes 83°10'50" E and 80°17'40" E. The total geographical area of the State is reported as 1,73,877 Sq Km.

The State comprises alluvial plains of Indo-Gangetic basin in the north and Kaimur-Chotanagpur-Santhal Pargana plateau in the south. The alluvial plains is divided into two by the river Ganga flowing from west to east. The State, therefore, can physiographically be divided into three regions, North, Central and South Bihar.

[Para 1.1]

1 The River Basins

For rational, comprehensive and integrated planning of the land and water resources, this Commission has divided the State into twentyone river basins named after the main rivers which drain them. Of these twentyone basins, seven are in North Bihar, six in Central Bihar and seven in South Bihar. Ganga Stem has been dealt as a separate basin. Keeping the requirements of detailed planning in mind, some of the basins have been further divided into sub-basins. These river basins/sub-basins with the names of the rivers into which the main rivers outfall are listed in Table 1 below:

Table 1

RIVER BASINS/SUB-BASINS IN BIHAR STATE

Sl no	Name of the main river/rivers	Alloted basin number	Outfall of the main river
1	Ghaghra	1	Ganga
2	Gandak	2	Ganga
3	Burhi Gandak	3	Ganga
4	Bagmati-Adhwara	4	Kosi
5	Kamla-Balan	5	Kosi
6	Kosi	6	Ganga

7	Mahananda	7	Ganga
8	Ganga Stem	14	Bay of Bengal
9	Kao-Gangi etc	14A	Ganga
10	Baya	14B	Ganga
11	Koa-Bhena etc	14C	Ganga
12	Mahi	14D	Ganga
13	Karmnasa	8	Ganga
14	Sone (Stem)	9	Ganga
15	Kanhar	9A	Sone
16	North Koel	9B	Sone
17	Punpun	10	Ganga
18	Kiul	11	Ganga
19	Harohar	11A	Kiul
20	Badua-Belharna	12	Ganga
21	Chandan-Bilasi-Chir	13	Ganga
22	Gumani	15	Ganga
23	Mayurakshi and other adjoining streams	16	Bhagirathi
24	Small streams draining independently outside the State	16A	Brahmani
25	Ajay	17	Bhagirathi
26	Sankh	18	South Koel
27	South Koel	19	Brahmani
28	Damodar	20	Bhagirathi
29	Barakar	20A	Damodar
30	Subernarekha	21	Bay of Bengal
31	Kharkai	21A	Subernarekha

These 31 basins/sub-basins have been regrouped into 26 composite basins taking into consideration the interbasin use of water. These composite basins alongwith its geographical area are as below:

Table 2

COMPOSITE RIVER BASINS

Sl no	Name of the basin	Geographical area(ha)
	NORTH BIHAR	
1	Ghaghra-Mahi-Western Gandak composite	648728
2	Upper Eastern Gandak-Upper Burhi Gandak composite	882398
3	Lower Eastern Gandak-Baya-Lower Burhi Gandak composite	675666
4	Bagmati-Adhwara	649985
5	Kamla-Balan	448767
6	Kosi	1141019
7	Mahananda	615006
	TOTAL NORTH BIHAR	5061569
8	Ganga Stem	547327

	CENTRAL BIHAR	
9	Karmnasa	512688
10	Sone & Kao-Gangi	937471
11	Punpun	902575
12	Harohar	1429618
13	Kiul	292732
14	Badua-Belhama	221500
15	Bilasi-Chandan-Chir	409305
	TOTAL CENTRAL BIHAR	4705889
	SOUTH BIHAR	
16	Gumani & Koa-Bhena	428608
17	Mayurakshi & Others	571218
18	Ajay	355365
19	Sankh	402743
20	South Koel	1058856
21	North Koel	1057436
22	Barakar	702600
23	Damodar	990780
24	Kharkai	420602
25	Subernarekha	859146
26	Small streams draining independently outside the State	168468
	TOTAL SOUTH BIHAR	7015822
	GRAND TOTAL	17330607

[Para 1.2]

2 Land Potential

As regards the area, the data were available from two sources (1) District Census Handbook (DCH),1981, published by Census Directorate, Govt of India and (2) data made available by the Directorate of Statistics and Evaluation of Govt of Bihar. These sources, however, gave two different sets of figures. Moreover, the total of Block areas (rural plus urban) in a district, as recorded in the DCH, did not tally with the district area shown in the same record. It was observed that this had happened because of the fact that some of areas of the C D Blocks were recorded as unsurveyed and the data on the area of such unsurveyed villages were not available. As most of the other basic data were blockwise, this Commission gave emphasis on assessment of the area of each block. This was achieved by measuring the unsurveyed areas on the Block maps and adding them to the area of surveyed villages as recorded in DCH.

'The total area of the State works out to 1,73,306.07 Sq Km, whereas the reported area of the State is 1,73,877 Sq Km. In order to sort out the matter a special meeting of the Commission was held in the Commission's office with the officials of the Directorate of Census of GOI, Directorate of Statistics and Evaluation of GOB and other officers and the matter was discussed in detail. It was finally decided to adopt, for the purpose of basin planning, the block and district areas as arrived at by this Commission.'

On the basis of districtwise data (1991) furnished by the State Statistics & Evaluation Directorate the overall land use pattern for the entire State is as below :

Table 3

LAND USE PATTERN OF THE STATE (1991)

			Area in Lha	Percentage of total Geographical Area
i	Geographical area		173.306	
ii	Forest		29.464	17.00
iii	Area under miscellaneous trees and groves		2.906	1.68
iv	a) Current fallow (1 year)	17.515		
	b) Other fallow (2 to 5 year)	9.913	31.088	17.94
	c) Culturable waste	3.660		
v	Net area under cultivation		76.940	44.39
vi	Barren land & Permanent pastures		12.267	7.08
vii	Area not available for cultivation		20.641	11.91
Total (ii to vii)		173.306	100.00	

The basinwise land use pattern is shown in Annex 1/1.

The table below shows the changes in land use pattern in the last 20 years (1971 to 1991)

Table 4

LAND USE PATTERN BETWEEN 1970-71 AND 1990-91

Sl no	Land Use	Area in Lha with percentage of the geographical area within the brackets				
		1970-71	1975-76	1980-81	1985-86	1990-91
1	Total Geographical Area	173.30	173.30	173.30	173.30	173.30
2	Forest	29.28 (16.90)	28.22 (16.28)	28.27 (16.31)	29.25 (16.88)	29.46 (17.00)
3	Barren and Unculturable	10.60 (6.12)	10.41 (6.01)	10.11 (5.84)	10.15 (5.85)	11.01 (6.35)
4	Land under Non–Agriculture use	15.45 (8.91)	16.50 (9.52)	17.17 (9.91)	19.61 (11.32)	20.64 (11.91)
5	Permanent Pasture & other grazing land	1.81 (1.04)	1.56 (0.90)	1.44 (0.83)	1.58 (0.91)	1.26 (0.73)
6	Miscellaneous Tree Crops and Groves	1.97 (1.14)	2.22 (1.28)	2.12 (1.22)	2.35 (1.35)	2.91 (1.67)
7	Culturable waste	5.13 (2.96)	4.65 (2.68)	4.42 (2.55)	3.98 (2.30)	3.66 (2.11)
8	Current Fallow	15.73 (9.08)	16.01 (9.24)	17.21 (9.23)	19.19 (11.08)	17.52 (10.11)
9	Other Fallow	8.79 (5.07)	9.02 (5.21)	9.39 (5.42)	10.16 (5.86)	9.91 (5.72)
10	Net sown Area	84.54 (48.78)	84.70 (48.88)	83.17 (47.99)	77.03 (44.45)	76.94 (44.40)

The land use for 20 years, from 1971 to 1991,reveals that the net sown area in the State has progressively diminished by 4.38 per cent of the geographical area. In twenty years it has undergone reduction by 9 per cent. This appears to have happened due to various developmental works such as construction of dams and reservoirs, roads, embankments, canals, setting up of new industries, development of market places, growth of towns and villages due to the population explosion, etc which have occupied additional land in their strides.

[Para 2.1 & 2.3]

3 The Culturable Area

The total cultivated area in the State is 76.94 Lha, which is 44.39 per cent of the geographical area. Adding to it 31.088 Lha area under current fallow, other fallow and culturable waste, the total culturable area of the State is 108.028 Lha. The Commission feels that considering the pressure on land and need for its development for increasing the food production of the State, attempt should be made to identify the reasons for such a vast area lying fallow or going waste. Accounting for the reduction in the cultivable area due to various developmental activities, which is expected to be 5 per cent in the next 10 to 20 years and diversion of other fallow and culturable waste for forest/orchard development, the net cultivable area for which crop cultivation/irrigation planning need be done would be 90.21 Lha.

[Para 2.5]

4 Cropping Pattern

All the river basins are covered under one or the other agro-climatic zone, the rainfall and soil variations of which have governed the formulation of separate cropping pattern envisaging the intensity of cropping and irrigation intensity for each. The following overall features of the State emerge about existing status :-

1	Total culturable area	–	108.028	Lha
2	Net cropped area	–	76.94	Lha
3	Gross cropped area	–	105.71	Lha
4	Cropping intensity	–	137.39	per cent of net sown area
5	Net irrigated area	–	32.00	Lha
6	Gross irrigated area	–	43.01	Lha
7	Irrigation intensity	–	134.40	per cent of net irrigated area
			55.90	per cent of net cropped area
			39.80	per cent of total culturable area

The existing cropping pattern of the State basinwise, regionwise is placed at Annex 1/2.

[Para 4]

5 Water Resources

Surface Water

Seventyfive per cent dependable surface water availability from different river basins has been worked out by this Commission on the basis of data made available by the CWC and Hydrology Cell/ Advance Planning Wing of the GOB. Availability has been worked out separately from catchment area of each basin falling outside the State and within the State except for Sone basin where 75 per cent dependable annual inflow yield has been worked out at the Indrapuri Barrage as 17600 MCM (14.25 MAF).

The regionwise, basinwise surface water resource on 75 per cent dependability is as below:

Table 5

BASINWISE SURFACE WATER AVAILABILITY OF THE STATE

Sl no	Basin No		Name of basin/ Sub-basin	75 per cent dependable annual inflow yield in MCM
			NORTH BIHAR	
1	1		Ghaghra	68854.70
2	14B		Baya	1067.20
3	2		Gandak	51824.00
4	14D		Mahi	799.10
5	3		Burhi Gandak	4040.00
6	4		Bagmati-Adhwara	7265.30
7	5		Kamla-Balan	3250.00
8	6		Kosi	52219.00
9	7		Mahananda	9880.30
			TOTAL NORTH BIHAR	199358.70
10	14		Ganga Stem	87793.00
			CENTRAL BIHAR	
11	8		Kamnasa	1424.10
12	9	(a)	Sone upto Indrapuri (Including Kanhar, North Koel)	17600.00
	9	(b)	Sone below Indrapuri	335.00
13	10		Punpun	2254.00
14	11		Kiul	682.00
15	11A		Harohar	3328.30
16	12		Badua-Belharna	736.80
17	13		Bilasi-Chandan-Chir	1491.10
18	14A		Kao-Gangi	884.40
			TOTAL CENTRAL BIHAR	28735.20
			SOUTH BIHAR	
19	15		Gumani	840.60
20	14C		Koa-Bhena	822.00
21	16		Mayurakshi & others	2287.80
22	16A		Small streams draining independently outside of State	632.40
23	17		Ajay	1238.70
24	18		Sankh	2053.80
25	19		South Koel	4182.30
26	20		Damodar	3400.00
27	20A		Barakar	2400.00
28	21	(a)	Subernarekha at Kokpara	5600.00
		(b)	Below Kokpara	330.00
			TOTAL SOUTH BIHAR	23788.90*
			GRAND TOTAL	339675.80

Availability from North Koel is included in Central Bihar

[Para 5.3]

Ground Water

The regionwise, basinwise ground water availability of the State based on data furnished by SGWD is as below:

Table 6

BASINWISE GROUND WATER RESOURCES Unit: MCM

Sl no	Name of Basin	Total Ground Water Availability
	NORTH BIHAR	
1A	Ghaghra-Mahi-Western Gandak	1994.0
1B	Upper Eastern Gandak-Upper Burhi Gandak	3145.9
1C	Lower Eastern GandakBaya-Lower Burhi Gandak	2132.8
2	Bagmati-Adhwara	1863.8
3	Kamla-Balan	1189.9
4	Kosi	3700.0
5	Mahananda	2310.0
	TOTAL NORTH BIHAR	16336.4
6	Ganga Stem	1561.8
	CENTRAL BIHAR	
7	Karamnasa	1658.5
8	Sone, Kanhar & Kao-Gangi	2507.4
9	Punpun	2020.9
10	Kiul	279.3
11	Harohar	2806.8
12	Badua Belharna	590.5
13	Bilasi-Chandan-Chir	892.7
	TOTAL CENTRAL BIHAR	10756.1
	SOUTH BIHAR	
14	Gumani, Koa-Bhena	363.0
15	Mayurakshi etc	445.4
16	Ajay	253.0
17	Sankh	319.5
18	North Koel	680.0
19	Siuth Koel	694.0
20	Damodar	721.3
20A	Barakar	510.4
21	Subernrekha	634.3
21A	Kharkai	242.1
22	Small Streams	128.4
	TOTAL SOUTH BIHAR	4991.4
	GRAND TOTAL	33645.6

[Para 6.2]

6 Present Irrigation Potential and Water Utilisation

Major and Medium irrigation Schemes

27 major and 163 medium irrigation schemes have been completed by the WRD to utilise the surface water potential of the river basins of the State. A potential of 27.15 Lha has already been created. In addition, there are 18 major and 30 medium ongoing schemes. The total annual irrigation potential envisaged from the completed and ongoing schemes is 41.35 Lha. The culturable command area of these schemes is 39.69 Lha. Water utilisation through these schemes is envisaged to be 31278 MCM. The basinwise potential envisaged and water utilisation worked out on the basis of schemewise data is shown in Table 7.

Table 7

ENVISAGED POTENTIAL AND WATER UTILISATION THROUGH COMPLETED AND ONGOING MAJOR AND MEDIUM SCHEMES

Sl no	Name of Basin	Number of Schemes		CCA	Potential Envisaged in ha	Water utilisation in MCM
		Major	Medium			
	NORTH BIHAR					
1A	Ghaghra-Mahi-Western Gandak	1	0	449080	554460	3230.00
1B	Upper Eastern Gandak-Upper Burhi Gandak	2	0	406700	578800	3128.00
1C	Lower Eastern Gandak-Baya-Lower Burhi Gandak	0	0	175700	210850	1274.40
2	Bagmati-Adhwara	1	–	118300	134900	659.00
3	Kamla-Balan	1	2	252122	309921	1525.00
4	Kosi	1	0	464058	504890	4787.00
5	Mahananda	0	0	nil	nil	nil
	TOTAL NORTH BIHAR	6	2	1865960	2293821	14603.40
6	Ganga Stem	1	1	60850	72025	454.41
	CENTRAL BIHAR					
7	Karmnasa	5	4	259739	363412	2070.00
8	Sone & Kao-Gangi	1	13	411495	627225	5506.40
9	Punpun	3	15	345515	397225	2384.04
10	Harohar	7	31	199441	167406	1249.12
11	Kiul	3	7	96125	96286	453.30
12	Badua-Belharna	2	11	79049	67273	388.40
13	Bilasi-Chandan-Chir	2	8	136554	137885	796.00
	TOTAL CENTRAL BIHAR	23	89	1527918	1856712	12847.26
	SOUTH BIHAR					
14	Gumani & Koa-Bhena	2	5	49766	56312	215.77
15	Mayurakshi & Others	0	7	22016	21091	99.60
16	Ajay	2	2	66795	53552	121.65
17	Sankh	0	5	23706	16078	99.95
18	South Koel	0	14	41394	36547	221.10
19	North Koel	2	26	129770	106987	669.50

20	Barakar	0	9	19717	20707	128.91
21	Damodar	2	10	92076	88765	389.42
22	Kharkai	3	12	75400	85950	344.10
23	Subernarekha	4	9	146222	205932	1068.85
24	Small streams draining independently outside the State	0	3	2060	2290	13.93
	TOTAL SOUTH BIHAR	16	102	668922	694211	3372.78
	GRAND TOTAL	46	194	4123650	4916769	31277.85

Minor Irrigation Surface Water Schemes :

Minor irrigation schemes which utilise surface water comprise the Minor Irrigation reservoir/weir (MI) schemes, lift irrigation (LI) schemes and ahars (storage tanks). A memorandum has been submitted to the Commission by the Minor Irrigation Department, which encloses districtwise census report on number and potential of different minor irrigation schemes and various other statements. As per this report there are 747 MI and 2078 LI schemes in the State. The number of ahars is 39,009 out of which 4453 belong to the Govt and rest are private or belonging to public organisation. Annual irrigation potential envisaged through these completed and ongoing minor irrigation surface water schemes is 6.52 Lha utilising 2026 MCM of surface water. The basinwise potential and water utilisation is shown in Table 8 below:

Table 8

ENVISAGED POTENTIAL AND WATER UTILISATION THROUGH COMPLETED AND ONGOING MINOR IRRIGATION SURFACE WATER SCHEMES

Sl no	Name Of Basin	Potential in ha				Water Utillisation in MCM			
		Reservoir	Lift	Ahars	Total	Reservoir	Lift	Ahars	Total
	NORTH BIHAR								
1A	Ghaghra-Mahi-Western Gandak	NA	12236	708	12944	NA	42.9	2.5	45.4
1B	Upper Eastern Gandak-Upper Burhi Gandak	NA	19875	11720	31595	NA	69.6	11.7	81.3
1C	Lower Eastern Gandak-Baya-Lower Burhi Gandak	NA	21432	775	22207	NA	75	0.8	75.8
2	Baghmati-Adhwara	6200	21119	1293	28612	21.7	73.9	1.3	96.9
3	Kamla-Balan	6103	9042	NA	15145	14.2	31.6	0	45.8
4	Kosi	1285	11650	328	13263	4.5	41.1	0.5	46.1
5	Mahananda	1136	5636	139	6911	4	19.7	0.1	23.8
	TOTAL NORTH BIHAR	14724	100990	14963	130677	44.4	353.8	16.9	415.1
6	Ganga Stem	6521	12543	5912	24976	22.8	43.9	5.9	72.6
	CENTRAL BIHAR								
7	Karmnasa	13524	7199	NA	20723	47.3	25.2	NA	72.5
8	Sone & Kao-Gangi	2768	7621	50995	61384	86.5	26.7	51	164.2
9	Punpun	13551	5625	NA	19176	47	197	NA	244
10	Harohar	54286	6000	NA	60286	190	21	NA	211
11	Kiul	16400	3052	NA	19452	57.4	10.68	NA	68
12	Badua-Belharna	10545	6325	NA	16870	36.9	22.1	NA	59
13	Bilasi-Chandan-Chir	23924	12662	NA	36586	83.7	44.3	NA	128
	TOTAL CENTRAL BIHAR	134998	48484	50995	234477	548.8	346.98	51	946.78

	SOUTH BIHAR								
14	Gumani & Koa-Bhena	1949	7079	19176	28204	6.83	24.18	19.18	50.19
15	Mayurakshi & Others	1909	13130	18197	33236	6.7	45.9	18.2	70.8
16	Ajay	3040	9740	NA	12780	10.7	34.09	NA	44.79
17	Sankh	2849	8611	NA	11460	10	30.1	NA	40.1
18	South Koel	6058	12878	NA	18936	19.2	45.1	NA	64.3
19	North Koel	5362	7751	36557	49670	18.8	27.1	36.56	82.46
20	Barakar	1792	6603	19500	27895	6.28	23.12	19.5	48.9
21	Damodar	2755	9763	28784	41302	9.64	34.16	28.78	72.58
22	Kharkai	2997	8005	1902	12904	10.49	28.02	1.9	40.41
23	Subernarekha	2593	13451	4224	20268	9.09	47.11	4.22	60.42
24	Small streams draining Independently Outside the State	2006	3400	NA	5406	4.83	11.8	NA	16.63
	TOTAL SOUTH BIHAR	33310	100411	128340	262061	112.56	350.68	128.34	591.58
	GRAND TOTAL	189553	262428	200210	652191	728.56	1095.36	202.14	2026.06

Minor Irrigation Ground Water Schemes

There are about 5790 deep tubewells, 5,93,540 shallow tubewells and about 3,96,640 dugwells (with or without pumps) through which ground water is utilised for irrigation purposes. The total irrigation potential envisaged through these schemes is 29.87 Lha. The basinwise details is shown in Table 9.

Table 9

ENVISAGED POTENTIAL AND WATER UTILISATION THROUGH COMPLETED GROUND WATER STRUCTURES

Sl no	Name of Basin	Total nos in the basin			Potential Enivsaged in ha				Water Utilisation in MCM			
		Dugwells	Shallow Tube wells	Deep T W	Dugwells	Shallow Tube wells	Deep Tube wells	Total	Dugwells	Shallow Tube wells	Deep Tube wells	Total
	NORTH BIHAR											
1A	Ghaghra-Mahi-Western Gandak	17485	68509	265	31424	306199	25614	363237	111.0	1082.0	89.7	1282.7
1B	Upper Eastern Gandak -Upper Burhi Gandak	84	34974	674	142	102809	80880	183831	0.6	333.9	320.8	655.3
1C	Lower Eastern Gandak Baya-Lower Burhi Gandak	2638	85598	529	6493	277377	63480	347350	22.7	942.8	251.8	1217.3
2	Bagmati Adhwara	258	52030	588	447	182724	66326	249497	1.4	621.6	265.3	888.3
3	Kamla Balan	13	21845	311	14	82859	37320	120193	0.1	293.5	148.0	441.6
4	Kosi	114	78496	472	199	235488	59000	294687	0.7	824.2	206.5	1031.4
5	Mahananda	-	37084	115	-	111252	13800	125052	-	471.7	54.7	526.4
	TOTAL NORTH BIHAR	20592	378536	2954	38719	1298708	346420	1683847	136.5	4569.7	1336.8	6043.0
6	Ganga Stem	6296	33944	262	12220	106389	31440	150049	42.8	372.8	124.7	540.3
	CENTRAL BIHAR											
7	Karmnasa	15328	20456	255	44504	71492	39600	155596	155.8	250.2	107.1	513.1
8	Sone	23279	39366	887	26647	76903	106440	209990	94.0	269.0	422.2	785.2

9	Punpun	40969	46340	566	36165	39020	67920	143105	126.0	487.0	269.4	882.4
10	Harohar	55892	50418	598	114412	151254	71760	337426	399.4	529.4	284.6	1213.4
11	Kiul	6396	4596	133	13058	13788	16625	43471	45.7	48.3	58.2	152.2
12	Badua Belharna	5263	6480	41	8554	18134	4920	31608	29.6	63.5	19.5	112.6
13	Bilasi-Chandan-Chir	11607	6303	95	17611	21518	11400	50529	61.6	75.3	45.2	182.1
	TOTAL CENTRAL BIHAR	158734	173959	2575	260951	392109	309665	962725	912.1	1722.7	1206.2	3841.0
	SOUTH BIHAR											
14	Gumani Koa Bhena	5968	3146	-	6956	6079	-	13035	24.4	21.3	-	45.6
15	Mayurakshi & Others	11504	1819	-	9679	1947	-	11626	33.9	6.8	-	40.7
16	Ajay	6675	-	-	2940	-	-	2940	10.3	-	-	10.3
17	Sankh	13012	-	-	8128	-	-	8128	28.4	-	-	28.4
18	South Koel	44304	-	-	30945	-	-	30945	225.2	-	-	225.2
19	North Koel	30654	119	-	34218	428	-	34646	119.8	1.5	-	121.3
20	Barakar	26033	-	-	23664	-	-	23664	88.7	-	-	88.7
21	Damodar	43382	-	-	35227	-	-	35227	123.3	-	-	123.3
22	Kharkai	2743	4	-	3662	8	-	3670	11.2	0.0	-	11.2
23	Subernarekha	25360	1511	-	19969	3022	-	22991	55.9	9.1	-	65.0
24	Small Streams Draining Independently Outside the State	1431	499	-	1740	1620	-	3360	6.1	5.7	-	11.7
	TOTAL SOUTH BIHAR	211066	7098	-	177128	13104	-	190232	727.1	44.4	-	771.5
	GRAND TOTAL	396642	593537	5791	489018	1810310	687525	2986853	1818.5	6709.6	2667.7	11195.8

Water Utilisation for Non-Irrigational Use

Drinking and Municipal Use

The drinking water requirement for each of the river basins has been worked out on the basis of the blockwise data made available by the Public Health Engineering Department of GDB. According to the prescribed norms, the per capita consumption adopted by them is 70 lit/day for rural area and 100 to 140 lit/day for urban area depending upon the class of the town. The total requirement of the State for a population of 863.74 Lakh (1991 census) works out to 2,367 MCM. It has been noticed that in North and Central Bihar generally ground water is used for drinking purposes as it obvitates costly water treatment. In South Bihar where it is not easy to exploit ground water in large quantities, surface water is commonly used for drinking and domestic purposes in urban areas. However, in rural areas ground water is used through domestic and public dugwells and tubewells. Basinwise details of water utilisation for the purpose are given in Table 10. Out of 2,367 MCM of water used of drinking purpose 82 MCM of water comes from surface water and 2,285 MCM of water from ground water.

Drinking Water Requirement for Livestock

Details of number of livestock has been furnished by Department of Statistics and Evaluation pertaining to the year 1982. Based on available informations we have adopted 2 per cent per year increase in number of livestock population. With the rate of increase the number for the year 1991 works out to 427 Lakh. Considering water consumption to be 10 lit/day/head, total consumption of water at present for livestock of the State works out to 159 MCM. Most of it comes from surface water. Basinwise utilisation for this purpose is shown in Table 10.

Requirement for Industrial Use & Railways

Present water consumption by industries in the State has been worked out from the information procured from the State Department of Industries. The department has furnished districtwise lists of large, medium, small and tiny industries alongwith number of handicraft centres. Water consumption by large and medium industries has also been furnished by the department. But in absence of any information about consumption of water by small & tiny industries and handicraft centres it has been assumed that a small industry may consume 4000 lit/day, a tiny industry 2000 lit/day and a handicraft centre 500 lit/day. For each important railway station the consumption has been taken to be 5 Lakh lit/day on the basis of sample data for Ajay and Kiul-Harohar basin.

On these assumptions, and actual consumption in case of large and medium industries, the present water consumption for industries and railways has been worked out basinwise which totals for the State as 768.5 MCM of which 671.3 MCM comes from surface water and rest (97.2 MCM) from ground water. Basinwise details are given in Table 10.

Table 10

PRESENT STATUS OF CONSUMPTION OF SURFACE AS WELL AS GROUND WATER BY HUMAN, LIVE STOCK AND INDUSTRY INCLUDING RAILWAY Unit-MCM

Sl no	Name of Basins	Human		Live Stock	Industries & Rly		Total S W	Total G W
		S W	G W	(S W)	S W	G W		
	NORTH BIHAR							
1A	Ghaghra-Mahi-Western Gandak	155.4		6.6	2.2		6.6	157.6
1B	Upper Eastern Gandak-Upper Burhi Gandak	138.5		8.4	2.5		8.4	141.0
1C	Lower Eastern Gandak-Baya-Lower Burhi Gandak	192.0		7.4	5.6		7.4	197.6
2	Bagmati Adhwara	141.3		6.8	4.9		6.8	146.2
3	Kamla Balan	101.8		2.2	3.4		2.2	105.2
4	Kosi	177.6		15.9	3.0		15.9	180.6
5	Mahananda	100.9		6.7	1.4		6.7	102.3
	TOTAL NORTH BIHAR	1007.5		54.0	23.0		54.0	1030.5
6	Ganga Stem	159.3		5.5	24.0		5.5	183.3
	CENTRAL BIHAR							
7	Karmnasa	127.0		3.9	3.6		3.9	130.6
8	Sone	135.0		7.5	6.3		7.5	141.3
9	Punpun	80.0		7.0	19.0		7.0	99.0
10	Harohar	110.0		13.5	8.7		13.5	118.7
11	Kiul	20.0		2.1	8.0		2.1	28.0
12	Badua Belharna	28.9		2.3	2.2		2.3	31.1
13	Bilasi-Chandan-Chir	60.6		4.5	2.3		4.5	62.9
	TOTAL CENTRAL BIHAR	561.5		40.8	50.1		40.8	611.6

	SOUTH BIHAR							
14	Gumani & Koa-Bhena		98.2	4.5	4.4		8.9	98.2
15	Mayurakshi & Others		41.0	3.4	3.1		6.5	41.0
16	Ajay		14.5	4.0	6.0		10.0	14.5
17	Sankh	1.0	11.1	2.8	0.2		4.0	11.1
18	South Koel	6.8	38.1	7.5	1.2		15.5	38.1
19	North Koel		50.6	6.5	3.5	0.1	10.0	50.7
20	Barakar		63.9	6.1	2.5		8.6	63.9
21	Damodar		166.1	8.7	464.9		473.6	166.1
22	Kharkai	10.2	18.1	3.1	28.0		41.3	18.1
23	Subernarekha	64.4	45.9	10.1	157.2		231.7	45.9
24	Small Streams Draining Independently Outside the State		8.6	1.8	0.3		2.1	8.6
	TOTAL SOUTH BIHAR	82.4	556.1	58.5	671.3	0.1	812.2	556.2
	GRAND TOTAL	82.4	2284.4	158.8	671.3	97.2	912.5	2381.6

7 Balance Water

Subtracting the total water utilisation through the completed and ongoing major, medium and minor schemes at their optimum efficiency and non-irrigational use such as municipal, livestock and industries from the total availability, the balance water works out as below:

Table 11

DETAILS OF BALANCE WATER RESOURCES Unit: MCM

Sl no	Name of Basin	SURFACE WATER					GROUND WATER		
		Total Availability	Utilisation		Balance	Received From Other Basin	Total Availa-bility	Utilisation	Balance
			In Own Basin	In Other Basin					
	NORTH BIHAR								
1A	Ghaghra-Mahi-Western Gandak	86981.7	3282.0	–	83699.7	–	1994.4	1440.3	554.1
1B	Upper Eastern Gandak-Upper Burhi Gandak	19347.9	3217.7	–	16130.2	–	3145.5	796.3	2349.2
1C	Lower Eastern Gandak-Baya-Lower Burhi Gandak	20415.1	1355.6	–	19059.5	–	2132.9	1414.9	718.0
2	Bagmati Adhwara	7265.3	795.7	–	6469.6	37.0	1864.0	1034.5	1071.8
3	Kamla Balan	3249.4	205.0	37.0	3007.4	1368.0	1190.0	546.8	643.2
4	Kosi	52219.0	4849.0	1368.0	46002.0+	–	3700.0	1212.0	2488.0
5	Mahananda	9880.3	30.5	–	9849.8	–	2310.0	628.7	1681.3
	TOTAL NORTH BIHAR	199358.7	13735.5	1405.0	184218.2	1405.0	16336.8	7073.5	9263.3
6	Ganga Stem	87793.0	266.7	564.1	86962.2	266.0	1561.8	723.3	838.5

	CENTRAL BIHAR								
7	Karmnasa	1424.1	496.0	–	928.1	1651.4	1658.0	643.7	1014.3
8	Sone*	16592.1	3861.4	3168.0	9562.7	–	2507.4	926.5	1580.9
9	Punpun	2253.5	443.0	–	1810.5	2192.0	2021.0	981.4	1039.6
10	Harohar	3328.3	1246.6	179.0	1902.7	227.0	2660.0	1332.1	1327.9
11	Kiul	682.0	424.8	–	257.2	98.7	426.0	180.0	246.0
12	Badua Belharna	736.8	449.7	–	287.1	–	590.5	143.7	446.8
13	Bilasi-Chandan-Chir	1491.1	841.5	–	649.6	104.5	892.7	245.0	647.7
	TOTAL CENTRAL BIHAR	26507.9	7763.0	3347.0	15397.9	4273.6	10755.6	4452.4	6303.2
	SOUTH BIHAR								
14	Gurnani & Koa-Bhena	1662.6	178.0	–	1484.6	209.0	363.0	143.9	219.1
15	Mayurakshi & Others	2287.8	176.9	–	2110.9	–	445.9	81.7	364.2
16	Ajay	1238.7	391.6	16.5	830.6	–	253.4	24.8	228.6
17	Sankh	2053.8	144.0	–	1909.8	–	319.5	39.5	280.0
18	South Koel	4183.6	300.9	–	3882.7	–	694.0	263.3	430.7
19	North Koel	2227.3	702.5	594.0	930.8	–	680.0	172.5	507.5
20	Barakar	2400.0	186.4	227.0	1986.6	–	510.4	152.6	357.8
21	Damodar	3400.0	1067.7	–	2332.3	–	721.3	289.4	431.9
22	Kharkai	1720.0	764.7	–	955.3	–	242.2	29.4	212.8
23	Subernarekha	4210.0	1521.6	–	2688.4	–	634.3	110.9	523.4
24	Small Streams Draining Independently Outside the State	632.4	32.7	–	599.7	–	128.4	20.3	108.1
	TOTAL SOUTH BIHAR	26016.2	5467.0	837.5	19711.7	209.0	4992.4	1328.3	3664.1
	GROUND TOTAL	339675.8	27232.2	6153.6	306290.0	6153.6	33646.6	13577.5	20069.1

+ Includes 541 MCM uses in Nepal.

* Including Kao-Gangi etc but excluding river North Koel.

Annex 1/1

BASINWISE EXISTING LAND USE PATTERN

Unit: ha

Sl no	Name of the basin	Geographical area	Forest Land	Land Under Misc Trees and Groves	Current Fallow	Other Fallow	Culturable waste	Net Area Under Cultivation	Barren Land & Permanent Pasture	Area Under Non-Agricultural use
	NORTH BIHAR									
1A	Ghaghra-Mahi-Western Gandak	648728	–	20145	22314	12434	1983	482423	25620	83809
1B	Upper Eastern Gandak-Upper Burhi Gandak	882398	91854	39281	36703	9484	5492	547355	11734	140495
1C	Lower Eastern Gandak-Baya-Lower Burhi Gandak	675666	–	27391	26465	5865	1402	459916	21450	133177
2	Bagmati-Adhwara	649985	–	27391	41713	7691	1111	431852	10643	129584
3	Kamla Balan	448767	–	18279	37173	4971	773	279401	16693	91477
4	Kosi	1141019	3297	34332	90052	31753	7086	709209	79257	186033
5	Mahananda	615006	1978	17347	59821	15968	3582	365766	49574	100970
	TOTAL NORTH BIHAR	5061569	97129	184166	314241	88166	21429	3275922	214971	865545
6	Ganga Stem	547327	6251	7856	45605	18297	6258	300289	46196	116575
	CENTRAL BIHAR									
7	Karmnasa	512688	122777	668	24377	4493	7884	289955	10911	51623
8	Sone, Kao & Kanhar	937471	161856	2466	80007	32967	7254	522440	37606	92875
9	Punpun	902575	121422	3106	110575	31607	6610	466894	50641	111520
10	Harohar	1429618	341392	8514	106371	62523	18631	665156	90434	136397
11	Kiul	292732	72230	2886	29101	17168	6920	61481	23848	59098
12	Badua-Belhama	221500	35763	2202	19309	9292	5146	98781	25273	25732
13	Bilasi-Chandan-Chir	409305	47167	5106	41573	26138	11374	167509	65304	43132
	TOTAL CENTRAL BIHAR	4705669	902607	24950	411313	186388	64021	2292216	304017	520377
	SOUTH BIHAR									
14	Gumani & Koa-Bhena	428608	62466	5617	63081	46175	14195	144640	59278	33136
15	Mayurakshi & Others	571218	71809	6773	81965	76040	34660	175830	69243	54898
16	Ajay	355365	56588	6917	43439	49298	21839	109557	34553	33174
17	Sankh	402743	61118	4834	100008	51246	16657	122914	25802	20164
16	South Koel	1056856	248238	10316	164136	96738	44871	317139	123807	53611
19	North Koel	1057436	439822	5491	164668	113287	25653	205829	56381	46305
20	Barakar	702600	232448	8850	78388	73536	26557	136334	72126	72361
21	Damodar	990780	337386	10654	109036	98931	32644	199813	103268	99048
22	Kharkai	420602	139387	4562	41287	16602	16666	109260	38071	54567
23	Subernarekha	859146	237036	7632	109546	66512	32053	255791	62828	87748
24	Small Streams Draining independently Outside the State	168468	54072	1968	24830	9921	8465	46098	16556	6558
	TOTAL SOUTH BIHAR	7015622	1940390	73614	980384	698486	274260	1825205	661913	561570
	GRAND TOTAL	17330607	2946377	290586	1751543	991337	365968	7693632	1227097	2064067

BASINWISE PRESENT CROPPING PATTERN AS PERCENTAGE OF NET CULTIVATED AREA (1991-92 DATA) Unit : Per cent

Sl No	Name of Basin	Net Cultivated Area in ha	BHADAI			KHARIF			RABI			GARMA			ANNUAL			GRAND TOTAL		
			Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total
1A	Ghaghra-Mahi-Western Gandak	482423	1.56	18.35	19.91	0.92	34.62	35.54	63.57	8.64	72.21	2.02	14.98	17.00	0.32	6.36	6.68	68.39	82.95	151.34
1B	Upper Eastern Gandak-Upper Burhi Gandak	547355	1.37	13.16	14.53	16.25	30.95	47.20	27.14	17.10	44.24	10.13	7.22	17.35	0.40	10.27	10.67	55.29	78.70	133.99
1C	Lower Eastern Gandak-Baya-Lower Burhi Gandak	459916	1.60	20.91	22.51	3.79	36.87	40.66	48.21	14.42	62.63	4.10	22.14	26.24	0.02	1.19	1.21	57.72	95.53	153.25
2	Bagmati-Adhwara	431852	3.01	17.66	20.67	5.94	59.46	65.40	34.86	14.06	48.92	3.33	6.71	10.04	0.12	2.02	2.14	47.25	99.91	147.16
3	Kamla-Balan	279401	1.95	16.32	18.27	8.44	79.40	87.84	29.10	15.12	44.22	2.30	12.10	14.40	0.00	0.43	0.43	41.79	123.37	165.16
4	Kosi	709209	0.14	2.02	2.16	17.79	43.80	61.59	32.81	14.11	46.92	12.71	32.89	45.60	0.05	0.36	0.41	63.50	93.18	156.68
5	Mahananda	365766	1.25	17.59	18.84	5.26	65.13	70.39	21.28	13.84	35.12	11.76	11.01	22.77	0.00	0.22	0.22	39.55	107.79	147.34
6	Ganga Stem	300289	0.05	2.94	2.99	12.64	13.04	25.68	33.85	26.28	60.13	3.47	6.77	10.24	0.06	0.06	0.12	50.07	49.09	99.16
7	Karmnasa	289955	0.02	0.61	0.63	58.34	3.61	61.95	35.52	24.47	59.99	0.72	0.52	1.24	0.58	0.00	0.58	95.18	29.21	124.39
8	Sone, Kao & Kanhar	522440	0.07	2.57	2.64	67.08	3.01	70.09	39.62	25.03	64.65	0.73	1.60	2.33	0.51	0.05	0.56	108.01	32.26	140.27
9	Punpun	466894	0.26	2.21	2.47	62.01	1.92	63.98	20.93	31.95	52.88	1.01	0.12	1.13	0.75	0.12	0.87	84.96	36.37	121.33
10	Harohar	665156	0.58	3.96	4.54	45.37	8.46	53.83	27.08	24.79	51.87	0.92	0.62	1.54	0.33	0.01	0.34	74.28	37.64	112.12
11	Kiul	81481	0.21	11.00	11.21	22.60	30.28	52.88	15.48	20.55	36.03	0.89	0.35	1.24	0.32	0.05	0.37	39.50	62.23	101.73
12	Badua Belharna	98781	0.53	8.72	9.25	40.50	32.41	72.91	16.59	16.21	32.80	1.41	1.43	2.84	0.27	0.07	0.34	59.30	58.84	118.14
13	Bilasi-Chandan-Chir	167509	0.39	8.22	8.61	40.77	34.05	74.82	11.37	13.09	24.46	1.14	0.82	1.96	0.43	0.04	0.47	54.10	56.22	110.32
14	Gumani Koa Bhena	144640	0.12	9.90	10.02	4.20	47.59	51.79	6.86	13.53	20.39	1.02	1.75	2.77	0.00	0.01	0.01	12.20	72.78	84.98*
15	Mayurakshi & Others	175830	0.22	13.25	13.47	1.76	89.03	90.79	4.85	6.06	10.91	0.53	1.06	1.59	0.00	0.03	0.03	7.36	109.43	116.79
16	Ajay	109557	0.01	6.30	6.31	1.80	76.70	78.50	5.53	0.48	6.01	0.33	0.08	0.41	0.01	0.02	0.03	7.68	83.58	91.26*
17	Sankh	122914	0.00	42.62	42.62	0.64	53.19	53.83	1.82	1.60	3.41	0.54	0.00	0.54	0.00	0.00	0.00	3.01	97.41	100.40
18	South Koel	317139	0.00	39.61	39.61	1.42	63.03	64.45	3.18	1.72	4.90	0.68	0.58	1.26	0.01	0.06	0.07	5.29	105.00	110.29
19	North Koel	205829	0.14	28.89	29.03	14.43	29.02	43.45	5.68	14.84	20.52	0.83	0.56	1.39	0.38	0.01	0.39	21.46	73.32	94.78*
20	Damodar	199813	0.02	22.80	22.82	3.64	71.67	75.31	5.03	2.55	7.58	0.89	0.27	1.16	0.02	0.00	0.02	9.60	97.29	106.89
21	Barakar	138334	0.11	17.17	16.25	3.43	86.37	89.60	6.66	1.91	8.57	0.72	1.23	1.95	0.00	0.00	0.00	10.92	105.65	116.57
22	Subernarekha	255791	0.03	16.83	17.20	2.90	66.38	69.28	2.12	1.64	3.76	0.91	0.49	1.40	0.00	0.00	0.00	5.96	85.68	91.64*
23	Kharkai	109260	0.00	5.13	5.13	5.19	94.43	99.62	0.46	2.63	3.09	0.09	0.14	0.23	0.02	0.00	0.02	5.76	102.33	108.09
24	Small Streams Draining Independently Outside the State	46098	0.07	13.27	13.34	0.97	91.25	92.22	1.08	2.17	3.25	0.76	1.00	1.76	0.00	0.00	0.00	2.88	107.69	110.57

* Data of these basins need reconciliation as gross coverage is reported to be less than net cultivated area. [Para 4.4]

VOLUME III

OUTLINE OF DEVELOPMENT AND MANAGEMENT OF LAND AND WATER RESOURCES OF DIFFERENT RIVER BASINS OF BIHAR (TOR 4)

Basinwise land and water-use plans have been prepared seperately for all the twentysix river basins/sub-basins of the State with specific recommendations. The salient features are as indicated below:

8 Land Use (Prospective)

With the implementation of the proposed basin plans the land use pattern is likely to go underchange as indicated in the following table.

Table 12

LAND USE PATTERN

Category	Existing (Lha)	Proposed (Lha)
Forest area	29.460 (17.00%)	53.120 (33.65%)
Land under miscellaneous trees and groves	2.906 (1.68%)	
Net area under cultivation	76.940 (44.39%)	90.210 (52.05%)
Barren land and permanent pasture	12.271 (7.08%)	4.477 (2.58%)
Current fallow, other fallow, culturable waste and area under non-agricultural use	51.729 (29.85%)	25.499 (14.72%)

(Figures within parentheses indicate percentage of geographical area).

9 Forest Cover

In the proposed land use plan, a fair proportion of land under the category of other fallow and culturable waste has been proposed for diversion to forestry/agro-forestry. This is considered desirable for the development of industries based on timber and other forest produce and industries for fruit production, preservation and processing etc, apart from meeting the ecological needs to a certain extent. Basinwise such feasible conversion is tabulated and presented in Annex 2/1.

The changes in the forest cover is likely to develop regionwise as below:

Table 13

REGIONWISE FEASIBLE AREA UNDER FORESTRY/AGRO-FORESTRY
(Existing and Proposed)

Unit: ha

Sl No	Name of Regions	Existing forest area	Proposed forestry/agro-forestry including existing area under forest and misc trees & groves
1	North Bihar	97,129 (1.92%)	5,81,666 (11.49%)

2	Ganga stem	6,251 (1.14%)	61,760 (11.28%)
3	Central Bihar	9,02,607 (19.18%)	13,82,786 (29.38%)
4	South Bihar	19,40,390 (27.66%)	32,85,685 (46.83%)
	Total	29,46,377 (17.00%)	53,11,897 (30.65%)

(Figures within parentheses indicate percentage of geographical area).

10 Cultivable Land

As most of the other fallow and culturable waste lands have been proposed for diversion for forest/agro-forest raising, generally the area under current fallow only will be available additionally for cultivation for producing cereals, pulses, oilseeds and vegetables, etc.

A study of the statistical figures of culturable area of the State for different years (vide report on TOR 2) indicates that it has progressively diminished by about 4.30 per cent within 20 years from 1971 to 1991. It is expected that this trend may continue for a considerable time in future when there may be further reduction of about another 5 per cent in next 10 to 20 years in net cultivable area for which crop cultivation/irrigation planning need be done.

Basinwise area likely to be available for crop cultivation has been assessed in the plans for each basin and is given in Annex 2/2. The total cultivable land in the State for agriculture is thus assessed to be about 90.21 Lha which comes to 52.05 per cent of the State area.

The regionwise probable net cultivated area after implementation of the plan may be as below:

Table-14

REGIONWISE PROBABLE NET CULTIVATED AREA IN THE STATE

Sl No	Region	Net area presently under cultivation		Area likely to be brought under cultivation	
		In ha	As percentage of geographical area	In ha	As percentage of geographical area
1	North Bihar	32,75,922	64.72	34,22,463	67.62
2	Ganga Stem	3,00,289	54.86	3,28,599	60.03
3	Central Bihar	22,92,216	48.71	25,68,353	54.58
4	South Bihar	18,25,205	26.02	27,01,620	38.51
	Total	76,93,632	44.39	90,21,035	52.05

[Para 1.1,1.2 & 1.3]

11 Non-agricultural Use of Water:

The non-agricultural use of water for domestic and municipal, livestock and industrial & commercial uses of water has been assessed on the basis of increase in human population and livestock number by 2025 AD and future growth of industries and commerce on pro rata basis.

Domestic Use

For assessing the domestic water requirement by 2025 AD the population has been projected for 2025 AD on the same growth rate as during the decade 1981-91.

Thw PHED has recommended consumption of water for domestic use as 70 litre per day per capita for rural area and 100 litre to 140 litre per capita per day for urban area depending on the class of cities. It has recommended 140 litre per capita per day for the towns like Patna, Ranchi, Jamshedpur, Dhanbad, Muzaffarpur and other important district towns and 120 litre per capita per day for the district and industrial towns like Nawada,Gaya,Pumea,Motihari, Giridih, Barauni, Dehri etc and 100 litre per capita per day for the new and small urban areas.

This has not indicated if there would be any increase in per capita rate of domestic consumption by 2025 AD. We however feel that the present per capita rate of consumption should be raised by 20 per cent considering rise in the standard of living in course of time. This premium will also account for likely rise in urban population due to the shifting of population from village to town.

Based on the above assumption the total projected domestic water requirement for the State by 2025 AD works out to 5708 MCM against the present assessed consumption of 2342 MCM.

Drinking Water for Livestock

The water requirement for livestock by 2025 AD has been assessed on the basis of projected population of livestock based on districtwise figure of number of livestock, available in Statistical Handbook 1982. Based on various reports, livestock population by 2025 AD has been projected assuming 2 per cent per year increase in its population. No data on rate of consumption of water by livestock was available. The Commission has assumed the rate of water consumption, on an average, to be 10 litre per day per head.

Based on the above consideration the total requirement of water for livestock of the State by 2025 AD works out to 311 MCM against the present estimated consumption of 159 MCM.

Water for Industrial Sector

Although we solicited a detailed note from the State Industries Department on present status and envisaged growth of industries in the State and sourcewise water requirement for the same, for which we had sent a detailed questionnaire but the Industries Department furnished only districtwise lists of existing large and medium industries with quantities of water utilised by them and a list of small and tiny industries and handicraft centres. As per the information received there are 228 number of large and medium industries in the private sector, 62 in the public sector and 15 in the joint sector. In addition there are 2,289 number of small scale and 63,006 number of tiny industries in the State. The number of handicraft centres is 1,16,720. Bulk of these industries are located in the river basins of the mineral belt namely, Ajay, Damodar, Subernarekha-Kharkai, South Koel and Sankh river basins of South Bihar. Barring only a few, large and medium industries in North and Central Bihar are yet to come up. However, the region has a number of small and tiny industries besides handicraft centres.

Due to non-availability of consumption of water by small and tiny industries and handicraft centres we have assumed, on the basis of information for medium industries, that a small industry may

consume about 4,000 litre of water per day, a tiny industry 2000 lit/day and a handicraft centre 500 lit/day. On the basis of sample data of water utilisation by railway stations water consumption by them, on an average, has been worked out as 5 lakh litre/day.

The total present water use by small and tiny industries, handicraft centres, railways and large and medium industries has been worked out for each basin. The total for the State comes to about 850 MCM in which ground water share is approximately 175 MCM. About 2352 MCM of water would be required for industrial use in the State including use by railways by 2025 AD.

Hence overall use of water for non-irrigational purposes under different category would be as below:

Table 15

NON-AGRICULTURAL USE OF WATER Unit-MCM

	Present use	Anticipated consumption by 2025 AD
Domestic	2342.00	5708.40
Live stock	159.00	310.81
Industrial & Commercial	850.00	2351.40
	3351.00	8370.61

Against 8370.61 MCM of anticipated consumption, 10730 MCM of surface water and 5194 MCM of ground water (atleast 15 per cent of the availability in both cases) have been reserved for future exigencies.

Basinwise anticipated consumption and provision of water resources made are given in Annex 2/3.
[Para 1.6 & 1.6.7]

12 Water Available for Irrigational Use:

Net quantity of water available for irrigational use after deducting MI uses and accounting for inter-basin transfer are indicated below:

Table 16

BASINWISE NET QUANTITY OF WATER AVAILABLE FOR AGRICULTURAL USE

	Name of basin	Surface water [MCM]	Ground water [MCM]
	NORTH BIHAR		
1	Ghaghra-Mahi-Western Gandak composite	5437.0	1695.4
2	Eastern Upper Gandak-Upper Burhi Gandak composite	6125.0	2673.0
3	Eastern lower Gandak-Baya–Lower Burhi Gandak composite	5236.0	1813.0
4	Bagmati-Adhwara	6902.0	1584.0

5	Kamla-Balan	4093.0	1011.0
6	Kosi	49537.0	3145.0
7	Mahananda	9240.1	1663.0
	TOTAL NORTH BIHAR	86570.1	13884.4
8	Ganga Stem	1439.9	1327.8
	CENTRAL BIHAR		
9	Karmnasa	2861.9	1409.8
10	Sone (Stem)-Kao-Kanhar composite	5031.0	2131.0
11	Punpun	4108.0	1717.0
12	Harohar	3371.8	2261.0
13	Kiul	678.7	362.0
14	Badua-Belharna	626.3	502.0
15	Bilasi-Chandan-Chir	1372.0	759.0
	TOTAL CENTRAL BIHAR	18049.7	9141.8
	SOUTH BIHAR		
16	Gumani & Koa-Bhena composite	1624.0	309.0
17	Mayurakshi & Other	1945.0	378.0
18	Ajay	974.7	215.0
19	Sankh	894.0	271.0
20	South Koel	1950.0	590.0
21	North Koel	1352.0	578.0
22	Barakar	2220.0	454.0
23	Damodar	2111.0	545.0
24	Subernarekha	1320.0	169.0
25	Kharkai	2414.0	476.0
26	Small streams draining independently out of the State	555.6	109.0
	TOTAL SOUTH BIHAR	17360.3	4094.0
	GRAND TOTAL	123420.0	28448.0

[Para 1.8]

13 Prospective Cropping Pattern

The cropping pattern likely to evolve by, say second or third decade after 2000 AD, has been visualised keeping in view the growth of State's population, food and fodder needs, requirements of raw materials for various agro-based industries, land use practices, growth of irrigational facilities, consumption trend of HYV seeds, fertilizers, pesticides, research and extension back-up and national priority relating to the production of commodities.

The extent of likely coverage seasonwise and cropwise has been projected separately for each basin and the same is to form a part of each basin plan. Availability of water resources and the

feasibility of its exploitation have formed the core of consideration while formulating normative cropping pattern of each basin. Other considerations like soil characteristic, socio-cultural preferences for crops, calorific value of crops to meet the human need, economic viability and environmental sustainability have also been given due weightage in prescribing prospective cropping pattern.

Each basin plan contains seasonwise projected crop coverage and irrigation intensities of the respective basin considered feasible when water resources would be fully utilised. In all basins rainfed cropping during kharif has been envisaged which includes mainly maize, millets, pulses, oilseeds, tubers, fibres and fodders etc. The plateau region, which has rolling topography and low depth of soil layers, has to face serious runoff losses. Scope exists there for cropping during monsoon months only and naturally rabi and summer coverage would continue to be poor. The uplands nicknamed as tanr lands situated near foot-hills may continue to be rainfed for many years to come.

The chaurs and lowlands of North Bihar spreading from Gopalganj to Kishanganj which get submerged during rains provide serious limitations to extensive irrigation in the area. The riverine belt of Ganga stem basin too presents such limitations. In future, say by the second/third decade after 2000 AD, irrigation intensity in the North Bihar basins has been visualised to go upto 162 per cent of cropped area, the lowest being 136 per cent in the Bagmati basin which has abundance of water resources but no infrastructure to tap the same for utilisation. The cropping intensity in North Bihar varies from 191 per cent to 205 per cent.

In the canal command areas of Central Bihar, lying mostly in the Gangetic alluvial zone, large scale multiple cropping encompassing numerous crops is extensively feasible. Sub-humid climate and alluvial soils with irrigation may support irrigation intensity and cropping intensity even upto 163 per cent and 183 per cent respectively. Among Central Bihar basins it is visualised that irrigation intensity may vary between 128 per cent and 163 per cent depending on the extent of implementation of the new schemes and modernisation of the existing ones.

The Chotanagpur-Santhal Pargana plateau basins, however, have serious limitations of physiography and land configuration. The irrigation intensity, in absence of adequate reservoir schemes, does not seem likely to go above 103 per cent, except in the Kharkai sub-basin having irrigation intensity of 151 per cent which may enjoy special benefit due to the proposed inter-basin transfer of water from the South Koel basin. The rock substratum of the terrain, dearth of schemes, heavy runoff of rain water and acidic soils of the region neither promote intensive cropping outside the monsoon period nor irrigated farming in very extensive dimension is feasible with the state of technology available at present. The lowest irrigation intensity of 75-77 per cent has been visualised in the Barakar and Damodar basin. About 87 per cent irrigation intensity in the Gumani basin, where there is little scope of large or medium reservoirs and a sizable land area lies over the coal belt of Santhal Paragana, has been envisaged. The lowest cropping intensity of 134 per cent to 139 per cent is visualised for the Ajay, Barakar, Damodar and Mayurakshi basins, where limitation of water availability due to the interstate agreement, and various other limitations, operate to bring down the cropping pattern. The Damodar and Barakar basins have limitations of micaceous soils in the upper reaches. Other basins of the region are expected to achieve a sustainable level of cropping intensity of about 157 per cent and above, provided other basic inputs of farming are provided.

A consolidated statement containing basinwise picture of cropping intensity as well as irrigation intensity has been presented in Table 18.

The regionwise prospective cropping pattern which is likely to develop is as below:

Table 17

Region	Culturable area	Percentage of CA to be cropped		Cropping intensity
		Rainfed	Irrigated	
North Bihar	3422463	50.9	147.7	198.6
Ganga Stem	328599	65.0	95.0	160.0
Central Bihar	2568353	45.2	136.8	182.0
South Bihar	2701620	56.2	91.1	147.3
Total Bihar	9021035	51.3	125.7	177.0

Basinwise prospective cropping pattern as envisaged are indicated below:

Table 18

BASINWISE PROSPECTIVE CROPPING PATTERN

Sl no	Name of the basin	CULTIVABLE AREA (ha)	PERCENTAGE OF CA TO BE CROPPED IN		CROPPING INTENSITY (%)
			Rainfed situation	Irrigated situation	
	NORTH BIHAR				
1	Ghaghra-Mahi-Western Gandak composite	491313	46	151	197
2	Upper Eastern Gandak-Upper Burhi Gandak composite	554850	49	142	191
3	Lower Eastern Gandak-Baya-Lower Burhi Gandak composite	462062	65	139	204
4	Bagmati-Adhwara	449887	59	136	195
5	Kamla-Balan	300745	59	143	202
6	Kosi	759298	43	162	205
7	Mahananda	404308	43	151	194
	TOTAL NORTH BIHAR	3422463	50.9	147.7	198.6
8	Ganga Stem	328599	65.0	95.0	160
	CENTRAL BIHAR				
9	Karmnasa	298615	26	162	188
10	Sone & Kao-Gangi U/S	132262	56	94	150
	(including Kanhar) D/S	440063	27	163	190
11	Punpun	548596	48	135	183

12	Harohar	732951	62	118	180
13	Kiul	105053	48	128	176
14	Badua-Belharna	112185	39	144	183
15	Bilasi-Chandan-Chir	198628	39	144	183
	TOTAL CENTRAL BIHAR	2568353	45.2	136.8	182
	SOUTH BIHAR				
16	Gumani & Koa-Bhena	197335	67	87	154
17	Mayurakshi & Others	244905	48	91	139
18	Ajay	192179	43	91	134
19	Sankh	211776	60	85	145
20	South Koel	457200	60	85	145
21	North Koel	351972	60	90	150
22	Barakar	201551	64	75	139
23	Damodar	287230	59	77	136
24	Kharkai	143020	34	151	185
25	Subernarekha	347070	54	103	157
26	Small Streams Draining Independently Outside the State	67382	59	89	148
	TOTAL SOUTH BIHAR	2701620	56.2	91.1	147.3
	GRAND TOTAL	9021035	51.3	125.7	177.0

Basinwise detailed prospective cropping pattern is given in Annex 2/4.

[Para 1.9]

14 Ultimate Water Utilisation

Ultimate irrigation water utilisation through different schemes is likely to develop as below:

i Through major and medium schemes

During study it was discovered that in cases of several major and medium schemes, irrigation potential envisaged were not commensurate with the water yield in the catchment, reservoir capacity or discharge of the streams in critical periods of irrigation. Corrections were applied wherever possible and corrected figures of quantities of irrigation water which these schemes could be relied upon to provide, were taken into consideration for irrigation planning in the concerned basins. Consequently, the irrigation potential assumed in these schemes also needed revision. These findings and suggestions have been indicated in different basin plans and in their enclosures.

Apart from completed and ongoing schemes and schemes in planning stage, some more schemes were identified during studies in the Commission. These also are listed with the different basin plans.

In-depth study reveals that these major and medium schemes appear to be capable of supplying

irrigation water in different regions of the State in different crop seasons, as mentioned in Table 19 totalling to 39579 MCM.

Table 19

EXPECTED ULTIMATE WATER UTILISATION OF SURFACE WATER THROUGH MAJOR AND MEDIUM SCHEMES (MCM)

Region	Kharif	Rabi	Hot weather	Total
North Bihar	9973	4753	3019	17745
Ganga Stem	286	217	200	703
Central Bihar	8837	3109	1007	12953
South Bihar	5991	1592	595	8178
Total	25087	9671	4821	39579

Basinwise details are given in Annex 2/5.

ii Through surface water minor irrigation schemes

Utilising the same norm of analysis, the realistic water yields from the existing surface water minor irrigation schemes were also assessed for each basin. The new surface water minor irrigation schemes have also been suggested wherever considered feasible. Block development officers of the State were requested to send the list of feasible minor irrigation schemes. Suggestions were invited for potential sites for probable minor irrigation schemes from Mukhias, Sarpanchs in their villages through their Block Development Officers. Reports from about hundred blocks were received. It might be investigated and acted upon. It may be worth while to obtain similar suggestions from Mukhias and Sarpanchs of rest of the blocks. Minor Irrigation Department made available to the Commission basinwise number of proposed minor irrigation schemes with potential envisaged to be created.

The existing and proposed surface water minor irrigation schemes are expected to supply irrigation water to the tune of 8516 MCM as detailed in Table 20.

Table 20

EXPECTED ULTIMATE UTILISATION OF SURFACE WATER THROUGH MINOR IRRIGATION SCHEMES

Region	Availability from surface water MI schemes (MCM)			
	Kharif	Rabi	Hot weather	Total
North Bihar	2721	387	–	3087
Ganga Stem	207	–	–	207
Central Bihar	2231	226	–	2457
South Bihar	2386	358	–	2744
Total	7545	971	–	8516

Basinwise details are given in Annex 2/5

iii Through ground water minor irrigation schemes

After meeting irrigational needs from surface water schemes the balance has to be met through ground water by pumping from ground water reservoir, even though it is costly. As there is absence of rain in rabi and garma seasons, ground water has been planned to be utilised mainly in these seasons. In the basins where ground water availability is poor, its exploitation during kharif has to be discouraged except for raising paddy seedlings which cover a small area and do not consume much water.

In the basins which have abundance of ground water there could be no restriction on use of ground water during kharif also. In practice it is, however, seen that the farmers keep their tubewells capped during rains and use them only sparingly to protect their crops due to rain or canal failures. Only State tubewells run during kharif as these are highly subsidised of which the farmers are quite unmindful. Hence any large-scale use of ground water during kharif has not been envisaged. Also, as exploitation of ground water consumes energy, priority has been assigned to utilisation of surface water first.

Through different basin plans, exploitation of ground water in different regions of Bihar has been envisaged as indicated in Table 21.

Table 21

EXPECTED ULTIMATE UTILISATION OF GROUND WATER Unit : MCM

Region	Seasonwise planned utilisation of ground water				
	Rabi	Hot weather	Additional Kharif & HW	Total	Remarks
North Bihar	3694	3472	2290	9456	
Ganga Stem	440	796	–	1236	
Central Bihar	3217	1962	1272	6451	
South Bihar	2055	1194	–	3249	
Total	9406	7424	3562	20392	

Basinwise utilisation of irrigation water is placed at Annex 2/5.

The basinwise overall utilisation of water (Surface and Ground) in M & I uses and irrigation combined with percentage of utilisation is placed at Annex 2/6A & Annex 2/6B.

[Para 1.11 & 1.11.4]

15 Ultimate Irrigation Potential

Previously, the cost of an irrigation scheme was the determining factor to categorise the irrigation scheme as major, medium or minor. Later on, the criteria were revised and the present criteria are based on culturable command area (CCA) of the schemes. The minor irrigation schemes are those which have CCA upto 2000 ha. The medium schemes are those which have CCA ranging from 2000 ha to 10,000 ha. The schemes having CCA of more than 10,000 ha are classified as major schemes. Because of the change of these criteria several old small irrigation schemes being maintained and operated by WRD now come under category of minor irrigation schemes. Such schemes still continue with the WRD. Some new irrigation schemes, whose investigation and planning were started considering them as medium schemes, on detailed scrutiny have become minor schemes on consideration of the

CCA. Irrigation potential of such schemes is therefore, deductible from the potential of the major and medium schemes and is to be added in the figure of overall potential of the minor irrigation schemes.

Ground water has been suggested to be primarily used for growing rabi and garma crops because in these crop seasons no rain water is available and discharges of the streams also reduce down to the minimum. Out of the 26 basins in the State 20 basins/sub-basins do not have enough ground water except for M & I uses and irrigation uses in rabi and garma crop seasons. Therefore, in these basins use of ground water during kharif has to be discouraged, except for growing paddy seedlings which cover a small area and do not consume much water.

However, the Gandak, Kamla, Kosi, Karmnasa, Sone and Punpun river basins have enough ground water left even after meeting the rabi and garma irrigation needs of these basins. The number and capacity of structures for exploitation of ground water will largely depend on the irrigation water requirement during rabi or garma which is expected to pose maximum demand on ground water. The pumping capacity of tubewells in these basins is likely to be of the order of about 3515 MCM. As these basins are surplus in ground water, this pumping capacity may be utilised in kharif also to give protection to kharif crops in case of rain or canal failures. The total crop area likely to face such situation and needing protection may be of the order of about 9.76 Lha. Of this 6.47 Lha would be in North Bihar and 3.29 Lha in Central Bihar.

In the background of foregoing analysis of factors governing the exploitation of irrigation potential of various sources and schemes and after making necessary adjustments the regionwise and sourcewise total potential has been worked out as 122.98 Lha which is hereafter presented in Table 22.

The regionwise irrigation potential which is likely to develop through major, medium and minor irrigation schemes are as below:

Table 22

REGIONWISE IRRIGATION POTENTIAL THROUGH DIFFERENT CATEGORIES OF SCHEMES

Unit: Lha

	Schemes	North Bihar	Ganga stem	Central Bihar	South Bihar	Total
A	**Through major & medium irrigation schemes**					
i	Completed and ongoing schemes with suggested modifications/extension	21.05	0.27	12.34	6.93	41.59
ii	Probable new schemes	9.24	0.85	9.18	6.79	26.06
	Subtotal	31.29	1.12	21.52	13.72	67.65
	Deduct on account of reclassification of some schemes as minor	(-)0.013	–	(-)0.387	(-)0.955	(-)1.355
	Total	31.277	1.12	21.133	12.765	66.295
B	**Through surface minor irrigation schemes**					
i	Existing minor schemes	1.30	0.25	2.35	2.62	6.52
ii	Probable additional potential	4.02	0.10	1.63	1.92	7.67
	Subtotal	5.32	0.35	3.98	4.54	14.19

Add on account of reclassification of some schemes as minor	(+)0.013	–	(+)0.387	(+)0.955	(+)1.355
Total	5.293	0.35	4.157	5.495	15.545
C Through ground water schemes (State and private tubewells and open wells etc)					
Existing & proposed structures	13.90	1.67	9.47	6.34	31.38
Add for kharif utilisation of tubewells in basins rich in ground water	(+)6.47	–	(+)3.29	–	(+)9.76
Total	20.37	1.67	12.76	6.34	41.14
Grand Total	56.98	3.14	38.26	24.60	122.98

Considering the uncertainly of kharif utilisation of ground water the irrigation potential likely to develop in the State may be restated as in Table 23.

Table 23

COMBINED WATER POTENTIAL OF MAJOR, MEDIUM AND MINOR IRRIGATION SCHEMES

	Irrigation Potential of Major, Medium and Minor Schemes (Lha)	Percentage with respect to envisaged cultivated area
North Bihar	50.51 to 56.98	147.60 to 166.50*
Ganga Stem	3.14	95.6
Central Bihar	34.97 to 38.26	136.80 to 148.98*
South Bihar	24.60	91.1
Overall for Bihar	113.22 to 122.98	125.70 to 136.33

* For details refer Appendix IV of Volume III.

Basinwise details are placed at Annex 2/7. [Para 1.12]

16 Foodgrain Production

The normative cropping pattern envisaged in the different river basins after exploitation of ultimate potential explicitly indicates the coverage of different crops by 2025 AD. The crop scenario likely to emerge is a mix of foodgrains, edible oilseeds, cash crops, vegetables, fodder, spices, condiments and fibres. But the State's primary concern is food and this priority would continue even in future since the population growth is not likely to slowdown. It, thus, remains relevant for the Commission to have an insight into the matter and to bring to light the state of affairs so far as foodgrain production is concerned. The State's envisaged requirement for the projected population in and about 2025 AD has been based on the population of the State as per census 1991 and its escalation at the preceding decennial growth rate of about 23.49 per cent. The Commission has already indicated in para 1.7 of its report under TOR 2 (Volumw II) the per capita foodgrain requirements for the various categories of manpower on the basis of age, nature of labour output and the dietary pattern. These requirements were derived from the study conducted by the State Planning Board. But the figures obtained from the Department of Agriculture which annually announces the State's requirement and also the draft proposals on the Eighth Five Year Plan, keep the norm of foodgrain requirement at 400 gm/capita/ day. Over and

above, seed and cattle-feed requirement have to be accommodated. After due consideration, the norm of 490 gm/capita/ day of pooled average population was considered reasonable and hence accepted. On the norm of 490 gm foodgrains/capita/ day, the State's annual requirement by 2025 AD may be around 315 Lakh MT. Basinwise details are given at Annex 2/8.

Anticipated increase in foodgrain production on implementation of suggested irrigation plans is indicated below:

Table 24

CONTEMPLATED COVERAGE AND PRODUCTION OF FOODGRAINS AFTER FULL DEVELOPMENT OF IRRIGATION

Name of the crop	Annual coverage by crop (Lha)	Annual production (Lakh MT)
Paddy	71.03	189.38
Wheat and barley	30.22	25.09
Maize and Millets	11.19	27.87
Pulses	16.52	21.04
Total	128.96	306.78

[Para 1.21]

Recommendations

17 Basinwise land and water use plans as contained in different 26 basin plans as indicated in the detailed report should be implemented.

18 The present forest cover is only 17 per cent of the total area of the State against the minimum requirement of 33 per cent for maintaining the ecological balance and environmental protection. The strategy to increase the forest cover in the State may be two-pronged. While the Govt may try to raise forest in the Govt lands which are lying barren or are under permanent pastures, the private land owners may be given sufficient incentive to raise forests or orchards in their fallow and culturable waste lands. Exemption of private forests and orchards from the Land Ceiling Act to a certain extent may be the most effective incentive to persuade the private land owners to raise forest or orchards.

[Para 1.2]

19 Diversion of culturable lands to other sectors would continue as a result of expansion in developmental infrastructures. But State's food and other needs would necessitate utilisation of current fallows to compensate the apprehended shrinkage.

[Para 1.3]

20 Even if data show that the present committed base flow and the domestic and industrial uses are far less than 15 per cent, at least 15 per cent of available water may be kept as reserve to meet the future exigencies

[Para 1.5.2]

21 Irrigation and multipurpose projects should include drinking water component also as far as practicable.

[Para 1.6.1]

There is about 60 potential sites for hydro-power generation capable of generating about 2650 MW of electricity in Bihar which needs to be harnessed. The short term advantages of inducting new thermal power projects has to be weighed against the long-term benefits from the hydel power projects.

[Para 1.6.5]

22 The cropping pattern likely to evolve by, say second or third decade after 2000 AD, has been visualised keeping in view the growth of State's population, food and fodder needs, requirements of raw materials for various agro-based industries, land use practices, growth of irrigational facilities, consumption trend of HYV seeds, fertilizers, pesticides, research and extension back-up and national priority relating to the production of commodities.

[Para 1.9]

23 Ground water should be utilised mainly for growing rabi and garma crops. In the basins where ground water availability is poor, its exploitation during kharif has to be discouraged except for raising paddy seedlings which cover a small area and do not consume much water. In the basins which have abundance of ground water there could be no restriction on use of ground water during kharif also.

[Para 1.11.3]

24 There are 10 potential sites in the Damodar-Barakar basin which could be investigated and structures constructed to irrigate 39,000 ha of culturable land of the basin utilising 224 MCM of surface water. Bihar may like to take up the matter with West Bengal so that surface water of the basin is allowed to be used by these schemes and any shortfall in the committed use by West Bengal may be met by ground water which is expected to be in abundance there (West Bengal).

[Para 1.12]

25 Execution of the individual basin plans may go a longway to change the drought scenario of the affected region of the State. Till the basin plans are executed works under DPAP have to be vigorously pursued.

Soil and water conservation measures under DPAP which are pre-requisite for successful cropping in the plateau and sub-plateau region need to be planned on watershed basis. Such identified schemes under 'NWDRA or State' sponsored plans should be financially supported.

The DPAP should revive the traditional system of irrigation such as ahars, pynes and gherabandi with technical refinement wherever possible. Sprinkler and drip irrigation should be encouraged in the drought prone areas to make optimal use of scarce water resources.

In Sankh and South Koel basins, a considerable amount of water, which cannot be utilised through surface flow irrigation, is flowing down into the neighbouring State. It needs to be investigated if this water could be lifted for increasing the irrigation coverage in North Koel, Sankh and South Koel basins. If found feasible the schemes will require large amount of power which can come from Himalayan reservoirs.

The catchment area which contributes water to form the reservoir behind the dam remains bereft of any irrigational advantage. Adequate power should be made available so that water could be lifted from the reservoir to meet the irrigation needs in the upper catchment areas.

[Para 1.14]

26 It is necessary to tap and utilise Ganga water to meet the shortfall of irrigation need in Central Bihar and to raise its irrigation intensity to the level atleast equal to that envisaged for North Bihar. On pro-rata basis it seems that about another 2,600 MCM of Ganga water may have to be planned to be transferred to the Central Bihar regions either by diversion through some structure

across the Ganga at appropriate place or lifting water from the Ganga through pumps making it possible to raise the average irrigation intensity of the region to atlaest 167 per cent. It is suggested to take up feasibility studies of such schemes at the earliest.

[Para 1.15]

27 In different basin plans of the State a very large quantity of water from surface and ground water reservoirs has been proposed to be utilised for irrigation through lifts. This will require enormous amount of power for which Himalayan reservoirs, where enormous potential for cheap hydropower production exists, deserves urgent consideration. The multipurpose role of reservoirs for irrigation, hydropower generation and flood mitigation need be highlighted to create awareness and consensus in the State and national lobbies.

Augmentation of lean flow discharge of the Ganga could be done by strict measures to stop further decrease in the flow of the Ganga at Buxar and by creation of reservoirs on the tributaries of the Ganga in the Himalayan region to store surplus monsoon water.

The contemplated Ganga-Brahmputra link can meet the water needs at Farakka more efficiently. If this link comes up it may reduce dependence of Farakka barrage on Himalayan reservoirs and may permit utilisation of Ganga water for irrigation and other purposes in Central Bihar even in the lean periods.

[Para 1.16]

28 It is recommended that the provision of the annual OMR fund should be as per actual requirement to be determined on the basis of actual ground survey to be carried out at the end of the rainy season every year. The OMR provision should be the first priority on the irrigation allotment so that the vital assets created so far may not get depreciated too fast affecting the performance of the whole department and ultimately causing set back to the food production programme in the State.

For optimum utilisation of water resources and irrigation potential of the State, integrated operation of major, medium and minor irrigation schemes is considered desirable where different types of schemes are operating in the same area supplementing each other with overlapping command areas. To achieve this, close co-ordination of field functionaries of irrigation and minor irrigation wings may be necessary.

The State may have to be divided into permanent irrigation circles and the circles could be treated as the units for command area development programmes under the leadership of Superintending Engineers.

All the major canal systems should be operated on warabandi/tatil system for which operation manuals will have to be prepared, tried and modified wherever necessary and then introduced for regular operation.

In the case of reservoir schemes the operation manuals should be prepared on the basis of seventyfive per cent dependable annual yield at the dam site, taking into consideration the operation table of the reservoir. In the case of diversion schemes, seventyfive per cent dependable ten-daily discharges of the streams should be taken into consideration for framing the operation manuals.

Agromet stations and computer system should be provided to enable adjustments in the operation schedules to incorporate sudden changes in the irrigation requirements according to changing soils, weather and stream flow conditions.

Kharif irrigation period for North Bihar should be advanced by atleast a month from the traditional schedule for providing canal water and charging water rates accordingly.

Even the farmers inside the canal commands should be given all possible incentive to develop their own tubewells/tanks for raising seedlings and also to supplement normal irrigation in case of short supply from the canal.

The Govt should ensure appropriate measures for effective implementation of the canal rules and discipline and safety of irrigation structures which deserve to be valued and adored as national assets.

[Para 1.17]

29 The full potential benefit of irrigation can be derived only when the command area is saturated with HYVs and quality seeds of the major crops along with fertiliser input and proper management of soil. Regular surveliance about likely incidence of pests and diseases should be made and farmers must be regularly fed with information through audio-visual media about the epidemic situation.

Govt should apply its mind to check unscientific fragmentation of the holdings leading to uneconomical sizes so that the economic viability of such farms may not be lost for ever.

The State Govt may like to constitute an Experts' Panel to identify the deficiencies of extension functioning and suggest suitable measures to reshape the extension services so that the transfer of technology may become smooth and expeditious.

[Para 1.18]

30 To prepare the contingent crop plan and its execution in flood ravaged areas there should be an organisational set-up at districts level consisting of District Agriculture Officer, District Animal Husbabdary Officer, District Fishery Officer, Executive Engineer (Flood Control) and one expert from Agriculture university.

[Para 1.19]

31 This Commission views with concern the problems of rainfed areas including the DPAP districts and desire that recommendations of the National Commission on Agriculture (1976) on this score should be put into use.

Rainfed technology should be developed and disseminated separately for North, Central and South Bihar.

Intensive land shaping, terracing, construction of water harvesting structures and installation of sprinkler system and drip irrigation equipments in rainfed areas shall have to be resorted to economise water use.

Research and extension support to such deficient areas must be vigorous so that productivity may not languish and wide disparity in economy between irrigated and rainfed zones may not crop up.

[Para 1.20]

32 Promotion of horticulture, fisheries and fodder is recommended to achieve food sufficiency apart from crop production.

[Para 1.21]

33 On Commission's enquiry some minor irrigation schemes proposed by Panchayats and collected through blocks are listed. Subject to their feasibility and resource permitting, they may be executed by the competant authority. The list, however, relate to few blocks only. Such public sponsored schemes may be procured from all blocks of the State. Adequate provisions for such minor irrigation schemes have been made in the basin plans.

Annex 2/1

ENVISAGED COVERAGE UNDER FOREST

Sl No	Name of the basin	Basin/ sub-basin no	Geographical area of the basin in ha	Existing forest		Area under misc trees & grooves in ha	Area to be brought		Total forest area	
				area in ha	As per centage of geographical area		from barren & permanent pasture in ha	from other fallow & cultuable waste in ha	area in ha	as per-centage of geographical area
	North Bihar									
1	Ghaghra-Mahi-Western Gandak composite	1,14D	648728	–	–	20145	20496	1983	42624	6.57
2	Upper Estern Gandak-Upper Burhi Gandak composite	2,14B	882398	91854	10.41	39281	9387	14976	155498	17.62
3	Lower Eastern Gandak-Baya-Lower Burhi Gandak composite	3	675666	–	–	27391	17160	7267	51818	7.67
4	Bagmati Adhwara	4	649985	–	–	27391	10643	8802	46836	7.20
5	Kamla Balan	5	448767	–	–	18279	16693	5744	40716	9.10
6	Kosi	6	1141019	3297	0.30	34332	79257	38839	155725	13.65
7	Mahananda	7	615006	1978	0.32	17347	49574	19550	88449	14.38
	Total North Bihar		5061569	97129	1.92	184166	203210	97161	581666	11.49
8	Ganga Stem	14	547327	6251	1.14	7856	23098	24555	61760	11.28
	Central Bihar									
9	Karmnasa	8	512688	122777	23.95	688	8728	12377	144570	28.20
10	Sone & Kao-Gangi	9,14A	937471	161856	17.27	2466	18803	40221	223346	23.82
11	Punpun	10	902575	121422	13.45	3106	40513	38417	203458	22.54
12	Harohar	11A	1429618	341392	23.86	8514	45217	81354	476477	33.33
13	Kiul	11	292732	72230	24.67	2886	19078	24088	118282	40.41
14	Badua-Belharna	12	221500	35763	16.14	2202	20218	14440	72623	32.79
15	Bilasi-Chandan-Chir	13	409305	47167	11.52	5108	52243	39512	144030	35.19
	Total Central Bihar		4705889	902607	18.26	24970	204800	250409	1382786	29.38
	South Bihar									
16	Gumani & Koa-Bhena	15,14C	428608	62486	14.58	5617	29639	60370	158112	36.89
17	Mayurakshi & Others	16	571218	71809	12.57	6773	34622	110700	223904	39.19
18	Ajay	17	355365	56588	15.92	6917	34553	21839	119897	33.74
19	Sankh	18	402743	61118	15.17	4834	12901	67903	146756	36.44
20	South Koel	19	1058856	248238	23.45	10316	61903	141609	462066	43.64
21	North Koel	9A	1057436	439822	41.59	5491	28190	138940	612443	67.92
22	Barakar	20A	702600	232448	33.08	8850	36063	100093	377454	53.72
23	Damodar	20	990780	337386	34.05	10654	51634	131575	531249	53.61
24	Kharkai	21A	420602	139387	33.14	4562	19036	33468	196453	46.70
25	Subernarekha	22	859146	237036	27.59	7632	31414	98565	374647	43.60
26	Small Streams Draining Independently Outside the State		168468	54072	32.09	1968	8278	18386	82704	49.09
	Total South Bihar		7015822	1940390	27.66	73614	348233	923448	3285685	46.83
	Grand Total		17330607	2946377	16.67	290606	779341	1295573	5311897	30.65

Annex 2/2

DETAILS OF BASINWISE AREA LIKELY TO BE BROUGHT UNDER CULTIVATION

Sl No	Name of the basin	Net cultivated area (ha)	Total area under current + other fallow + culturable waste (ha)	Area likely to be brought under cultivation (ha)	Net cultivable area 95% (3+5) (ha)	Percentage with respect to geographical area (ha)
1	2	3	4	5	6	7
	North Bihar					
1	Ghaghra-Mahi-Western Gandak composite	482423	36731	34748	491313	75.88
2	Upper Eastern Gandak-Lower Burhi Gandak composite	547355	51679	36703	554850	62.88
3	Lower Eastern Gandak – Baya-Lower Burhi Gandak composite	459916	33732	26465	462062	68.38
4	Bagmati Adhwara	431852	50515	41713	449887	69.21
5	Kamla Balan	279401	42917	37173	300745	67.01
6	Kosi	709209	128891	90052	759298	66.55
7	Mahananda	365766	79371	59821	404308	65.74
	Total North Bihar	3275922	423836	326675	3422463	67.62
8	Ganga Stem	300289	70160	45605	328599	60.03
	Central Bihar					
9	Karmnasa	289955	36754	24377	298615	58.24
10	Sone & Kao-Gangi	522440	120228	80007	572325	61.05
11	Punpun	466894	148992	110575	548596	60.78
12	Harohar	665156	187725	106371	732951	51.27
13	Kiul	81481	53189	29101	105053	35.88
14	Badua-Belharna	98781	33749	19309	112185	50.65
15	Bilasi-Chandan-Chir	167509	81085	41573	198628	48.53
	Total Central Bihar	2292216	661722	411313	2568353	54.88
	South Bihar					
16	Gumani & Koa-Bhena	144640	123451	63081	197335	46.04
17	Mayurakshi & Others	175830	192665	81965	244905	42.87
18	Ajay	109557	114576	92737	192179	54.08
19	Sankh	122914	167911	100008	211776	52.58
20	South Koel	317139	305745	164136	457200	51.68
21	North Koel	205829	303608	164668	351972	33.29
22	Barakar*	138334	178481	78388	201551	28.68
23	Damodar*	199813	240611	109036	287230	28.99
24	Kharkai	109260	74755	41287	143020	34.00
25	Subernarekha	255791	208111	109546	347070	40.40
26	Small Streams Draining Independently outside the State	46098	43216	24830	67382	40.00
	Total South Bihar	1825205	1953130	1029682	2701620	38.66
	Grand Total	7693632	3108848	1813275	9021035	52.11

*93% of column(3+5)

Annex 2/3

COMPARISON OF ANTICIPATED CONSUMPTION AND PROVISION OF WATER RESOURCES FOR NON-IRRIGATIONAL USE

Unit MCM

Sl No	Name of basin	Domestic use	Livestock use	Industrial and commercial	Anticipated total consumption	Provision of water resources		
						Surface water	Ground water	Total
	North Bihar							
1	Ghaghra-Mahi-Western Gandak composite	387.00	12.90	11.00	410.90	287.0	299.0	586.0
2	Eastern Upper Gandak-Upper Burhi Gandak composite	346.00	16.00	13.00	375.00	548.0	472.0	1020.0
3	Eastern lower Gandak-Baya-Lower Burhi Gandak composite	435.00	14.40	28.00	477.40	353.0	320.0	673.0
4	Bagmati-Adhwara	365.00	13.30	12.00	390.30	328.0	279.6	607.6
5	Kamla Balan	259.00	4.20	18.00	281.20	488.0	179.0	667.0
6	Kosi	439.00	32.00	95.00	566.00	773.0	555.0	1328.0
7	Mahananda	249.50	13.20	7.00	269.70	640.2	347.0	987.2
	Total North Bihar	2480.50	106.00	184.00	2770.50	3417.2	2451.6	5868.8
8	Ganga Stem	393.60	10.80	100.00	504.40	419.0	234.0	653.0
	Central Bihar							
9	Karmnasa	314.00	7.20	9.00	330.20	213.6	248.7	462.3
10	Sone (Stem) Kao-Gangi composite	334.00	14.60	35.00	383.60	440.0	376.0	816.0
11	Punpun	199.50	13.80	24.00	237.30	338.0	303.0	641.0
12	Harohar	271.90	26.30	50.00	348.20	500.0	399.0	899.0
13	Kiul	49.00	4.17	40.00	93.17	102.0	64.0	166.0
14	Badua-Belharna	71.40	4.50	10.00	85.90	110.5	88.5	199.0
15	Bilasi-Chandan-Chir	150.00	8.75	12.00	170.75	223.5	134.0	357.5
	Total Central Bihar	1389.80	79.32	180.00	1649.12	1927.6	1613.2	3540.8
	South Bihar							
16	Gumani & Koa-Bhena	89.00	9.00	20.00	118.00	249.0	54.0	303.0
17	Mayurakshi & Other	101.45	6.59	15.00	123.04	343.0	67.0	410.0
18	Ajay	35.80	7.90	30.00	73.70	247.8	38.0	285.8
19	Sankh	30.00	5.50	5.00	40.50	232.0	48.0	280.0
20	South Koel	109.25	14.80	6.00	130.05	605.0	104.0	709.0
21	North Koel	117.70	12.70	20.00	150.40	334.0	102.0	436.0
22	Barakar	170.00	12.00	12.00	194.00	138.0	56.0	194.0
23	Damodar	427.00	17.00	836.00	1280.00	1104.0	176.0	1280.0
24	Subernarekha	273.00	19.70	681.40	974.10	1293.0	158.0	1451.0
25	Kharkai	70.00	6.00	260.00	336.00	325.0	73.0	398.0
26	Small streams draining independently outside the State	21.30	3.50	2.00	26.80	95.0	19.0	114.0
	Total South Bihar	1444.50	114.69	1887.40	3446.59	4965.8	895.0	5860.8
	Grand total	5708.40	310.81	2351.40	8370.61	10729.6	5193.8	15923.4

Annex 2/4

BASINWISE PROSPECTIVE CROPPING PATTERN

Sl No	Name of the basin	Culti-vable Area in ha	Percentage of CA to be Cropped in Rainfed Situation					Percentage of CA to be Cropped in Irrigated Situation					Crop-ping Inte-nsity
			Kha-rif	Rabi	HW	Ann-ual	Total	Kha-rif	Rabi	HW	Ann-ual	Total	
		1	2	3	4	5	6	7	8	9	10	11	12
North Bihar													
1	Ghaghra-Mahi-Western Gandak composite	491313	17	27	2	-	46	68	53	20	10	151	197
2	Upper Estern Gandak-Upper Burhi Gandak composite	554850	17	29	3	-	49	63	49	15	15	142	191
3	Lower Eastern Gandak-Baya Lower Burhi Gandak composite	462062	31	25	9	-	65	59	55	20	5	139	204
4	Bagmati-Adhwara	449887	27	29	3	-	59	58	50	20	8	136	195
5	Kamla-Balan	300745	27	29	3	-	59	58	50	25	10	143	202
6	Kosi	759298	26	12	5	-	43	60	58	35	9	162	205
7	Mahananda	404308	29	10	4	-	43	51	61	24	15	151	194
	Total North Bihar	3422463	24.5	22.1	4.3	-	50.9	60	54	23.4	10.3	147.7	198.6
8	Ganga Stem	328599	19.0	35.0	11.0	-	65.0	25	40	28	2	95	160
	Central Bihar												
9	Karmnasa	298615	17	9	-	-	26	74	71	15	2	162	188
10	Sone & Kao-Gangi U/S	132262	56	-	-	-	56	54	34	3	3	94	150
	D/S	440063	13	14	-	-	27	74	71	16	2	163	190
11	Punpun	548596	16	32	-	-	48	72	52	9	2	135	183
12	Harohar	732951	26	36	-	-	62	55	50	11	2	118	180
13	Kiul	105053	17	31	-	-	48	68	47	11	2	128	176
14	Badua-Belharna	112185	18	21	-	-	39	75	56	10	3	144	183
15	Bilasi-Chandan-Chir	198628	18	21	-	-	39	75	56	10	3	144	183
	Total Central Bihar	2568353	20.8	24.4	-	-	45.2	67	56.2	11.4	2.2	136.8	182
	South Bihar												
16	Gumani & Koa-Bhena	197335	44	23	-	-	67	48	29	8	2	87	154
17	Mayurakshi & Others	244905	37	11	-	-	48	55	25	10	1	91	139
18	Ajay	192179	28	15	-	-	43	64	21	5	1	91	134
19	Sankh	211776	60	-	-	-	60	45	34	3	3	85	145
20	South Koel	457200	60	-	-	-	60	45	34	3	3	85	145
21	North Koel	351972	60	-	-	-	60	50	34	3	3	90	150
22	Barakar	201551	64	-	-	-	64	26	38	10	1	75	139
23	Damodar	287230	59	-	-	-	59	31	38	7	1	77	136
24	Kharkai	143020	34	-	-	-	34	80	55	15	1	151	185
25	Subernarekha	347070	54	-	-	-	54	55	36	9	3	103	157
26	Small Streams Draining Independently Outside the States	67382	59	-	-	-	59	45	36	7	1	89	148
	Total South Bihar	2701620	52.5	3.7	-	-	56.2	48.4	34	6.6	2.1	91.1	147.3
	Grand Total	9021035	31.6	17.7	2	-	51.3	57.2	48.2	15.1	5.2	125.7	177

Annex 2/5

DETAILS OF SOURCEWISE UTILISATION OF WATER RESOURCES

Unit : MCM

Sl No	Name of the basin	Major & Medium surface water schemes				Minor Irrigation Schemes					Total surface water	Total ground water
		Kharif	Rabi	H W & Annual	Total	Surface water		Ground water				
						Kharif	Rabi	Rabi	H W	Additional Kharif & HW*		
	North Bihar											
1	Ghaghra-Mahi-Western Gandak	2043.00	865.00	473.00	3381.00	129.00	–	367.00	320.00	414.00	3510.00	1101.00
2	Upper Estem Gandak Lower Burhi gandak composite	1859.00	653.00	617.00	3129.00	413.00	82.00	217.00	307.00	307.00	3624.00	831.00
3	Lower Eastern Gandak-Baya-Lower Burhi Gandak composite	1319.00	635.00	122.00	2076.00	453.00	68.00	418.00	490.00	490.00	2597.00	1398.00
4	Bagmati Adhwara	839.00	196.00	41.00	1076.00	466.00	70.00	724.00	634.00	–	1612.00	1358.40
5	Kamla Balan	752.00	426.00	347.00	1525.00	120.00	25.00	211.00	235.00	235.00	1670.00	681.00
6	Kosi	1980.00	1480.00	1327.00	4787.00	981.00	142.00	800.00	844.00	844.00	5910.00	2488.00
7	Mahananda	1181.00	498.00	92.00	1771.00	159.00		957.00	642.00	–	1930.00	1599.00
	Total North Bihar	9973.00	4753.00	3019.00	17745.00	2721.00	387.00	3694.00	3472.00	2290.00	20853.00	9456.40
8	Ganga Stem	286.00	217.00	200.00	703.00	207.00	–	440.00	796.00	–	910.00	236.00
	Central Bihar											
9	Karmnasa	1228.00	672.00	170.00	2070.00	208.00	40.00	231.00	272.00	272.00	2318.00	775.00
10	Sone & Kao-Gangi U/S	88.00	25.00	5.00	118.00	377.00	–	173.00	60.00	463.00	495.00	696.00
	Composite D/S	1946.00	1313.00	405.00	3664.00	171.00	–	124.00	403.00	–	3835.00	527.00
11	Punpun	1991.00	660.00	163.00	2814.00	576.00	115.00	537.00	308.00	537.00	3505.00	1382.00
12	Harohar	2178.00	183.00	210.00	2571.00	442.00	33.00	1418.00	559.00	–	3046.00	1977.00
13	Kiul	363.00	83.00	–	446.00	101.00	20.00	124.00	110.00	–	567.00	234.00
14	Badua-Belharna	386.00	47.00	–	433.00	119.00	18.00	224.00	110.00	–	570.00	334.00
15	Bilasi-Chandan-Chir	657.00	126.00	54.00	837.00	237.00	–	386.00	140.00	–	1074.00	526.00
	Total Central Bihar	8837.00	3109.00	1007.00	12953.00	2231.00	226.00	3217.00	1962.00	1272.00	15410.00	6451.00

Unit : MCM

Sl No	Name of the basin	Major & Medium surface water schemes				Minor Irrigation Schemes					Total surface water	Total ground water
		Kharif	Rabi	H W & Annual	Total	Surface water		Ground water				
						Kharif	Rabi	Rabi	H W	Additional Kharif & HW*		
	South Bihar											
16	Gumani & Koa-Bhena	323.00	50.00	1.00	374.00	245.00	45.00	157.00	142.00	–	664.00	324.00
17	Mayurakshi & Others	533.00	129.00	8.00	670.00	275.00	49.00	116.00	208.00	–	994.00	334.00
18	Ajay	596.00	79.00	–	675.00	204.00	32.00	83.00	75.00	–	911.00	158.00
19	Sankh	365.00	128.00	80.00	573.00	254.00	50.00	139.00	24.00	–	877.00	163.00
20	South Koel	698.00	191.00	132.00	1021.00	639.00	100.00	393.00	90.00	–	1760.00	486.00
21	North Koel	980.00	166.00	–	1146.00	164.00	–	361.00	173.00	–	1310.00	534.00
22	Barakar	235.00	55.00	–	290.00	106.00	–	255.00	169.00	–	396.00	424.00
23	Damodar	426.00	95.00	–	521.00	153.00	–	353.00	147.00	–	674.00	500.00
24	Kharkai	697.30	330.50	168.80	1196.60	46.70	–	7.50	7.20	–	1243.30	14.70
25	Subernrekha	1082.00	353.00	200.00	1635.00	159.00	32.00	152.00	121.00	–	1826.00	273.00
26	Small Streams Draining Independently Outside the States	56.00	16.00	5.00	77.00	141.00	50.00	38.00	35.00	–	268.00	73.00
	Total South Bihar	5991.30	1592.50	594.80	8178.60	2386.70	358.00	2054.50	1194.20	–	10923.30	3248.70
	Grand Total	25087.00	9671.50	4820.80	39579.60	7545.70	971.00	9405.50	7424.20	3562.00	48096.30	20391.70

* See Appendix IV of Volume III (TOR 4).

Annex 2/6A

DETAILS OF SURFACE WATER UTILISATION IN DIFFERENT RIVER BASINS OF BIHAR

Sl. No.	Name of Basin/ Sub-basin	M & I Uses		Major & Medium Sch		Minor Irr Sch		Water Transfer to other Basin		Release in River*		Total		Received from other Basin (MCM)
		Quantity (MCM)	%	Quantity (MCM)	%	Quantity (MCM)	%	Quantity (MCM)	%	Quantity (MCM)	%	Quantity (MCM)	%	
	North Bihar													
1	Ghaghra-Mahi-Western Gandak composite	287.0	5.01	3381.0	59.07	129.0	2.25	–	–	1927.0	33.67	5724.0	100	–
2	Upper Eastern Gandak Upper Burhi Gandak composite	548.0	8.30	3057.0	46.31	495.0	7.50	–	–	2501.0	37.89	6601.0	100	72.0
3	Lower Eastern Gandak-Baya Lower Burhi Gandak composite	353.0	6.32	2076.0	37.14	521.0	9.32	–	–	2639.0	47.22	5589.0	100	–
4	Bagmati Adhwara	328.0	4.51	1039.0	14.30	536.0	7.34	72.0	0.99	5290.0	72.86	7265.0	100	37.0
5	Kamla Balan	488.0	15.00	157.0	4.84	145.0	4.46	37.0	1.14	2423.0	74.56	3250.0	100	1368.0
6	Kosi	773.0	1.48	4787.0	9.17	1123.0	2.15	1368.0	2.62	44168.0	84.58	52219.0	100	–
7	Mahananda	640.2	6.48	1771.0	17.92	159.0	1.61	–	–	7310.1	73.99	9880.3	100	–
	Total North Bihar	3417.2		16268.0		3108.0		1477.0		66258.1		90528.3		1477.0
8	Ganga Stem	419.0	15.00	437.0	15.65	207.0	7.41	1200.1	42.97	529.9	18.97	2793.0	100	266.0
	Central Bihar													
9	Karmnasa	213.6	15.00	419.0	29.42	248.0	17.42	–	–	543.5	38.16	1424.6	100	1651.4
10	Sone & Kao-Gangi	440.0	5.15	3286.0	38.42	548.0	6.41	3577.0	41.82	701.0	8.20	8552.0	100	496.0
11	Punpun	338.0	15.00	622.0	27.60	691.0	30.65	–	–	603.0	26.75	2254.0	100	2192.0
12	Harohar	500.0	15.00	1848.5	55.50	475.0	14.30	179.0	5.40	325.8	9.80	3328.3	100	722.5
13	Kiul	102.0	14.96	446.0	65.40	121.0	17.74	–	–	13.0	1.90	682.0	100	98.7
14	Badua-Belharna	110.5	15.00	433.0	58.77	137.0	18.59	–	–	56.3	7.64	736.8	100	–
15	Bilasi-Chandan-Chir	223.5	15.00	733.0	49.16	237.0	15.90	–	–	297.5	19.94	1491.0	100	104.5
	Total Central Bihar	1927.6		7787.5		2457.0		3756.0		2540.1		18468.2		5265.1

Contd.

Sl. No.	Name of Basin/ Sub-basin	M & I Uses		Major & Medium Sch		Minor Irr Sch		Water Transfer to other Basin		Release in River*		Total		Received from other Basin (MCM)
		Quantity (MCM)	%	Quantity (MCM)	%	Quantity (MCM)	%	Quantity (MCM)	%	Quantity (MCM)	%	Quantity (MCM)	%	
	South Bihar													
16	Gumani & Koa-Bhena	249.0	14.97	165.0	9.92	290.0	17.44	–	–	959.0	57.67	1663.0	100	210.0
17	Mayurakshi & Others	343.0	15.00	670.0	29.28	324.0	14.16	–	–	951.0	41.56	2288.0	100	–
18	Ajay	247.8	20.00	675.0	54.48	236.0	19.05	16.5	1.33	63.7	5.14	1239.0	100	–
19	Sankh	232.0	15.00	573.0	37.04	304.0	19.65	18.2	1.17	419.8	27.14	1547.0	100	–
20	South Koel	605.0	15.00	1021.0	25.30	739.0	18.30	1035.0	25.70	630.0	15.60	4030.0	100	–
21	North Koel	334.0	15.00	737.0	33.00	164.0	7.36	950.0	42.66	42.0	1.89	2227.0	100	409.0
22	Barakar	138.0	5.75+	105.0	4.37	106.0	4.42	227.0	9.46	1824.0	76.00	2400.0	100	185.0
23	Damodar	1104.0	32.47+	521.0	15.32	153.0	4.50	185.0	5.44	1437.0	42.27	3400.0	100	–
24	Kharkai	325.0	30.00	637.6	58.70	46.7	4.30	–	–	75.7	7.00	1085.0	100	560.0
25	Subernarekha	1293.0	40.00	1265.0	39.10	191.0	5.90	–	–	483.0	15.00	3232.0	100	475.0
26	Small Streams Draining Independently outside the State	95.0	15.07	77.0	12.10	191.0	30.10	–	–	269.4	42.80	632.4	100	18.2
	Total South Bihar	4965.8		6446.6		2744.7		2431.7		7154.6		23743.4		1857.2
	Grand Total	10729.6		30939.1		8516.7		8865.3		76482.2		135532.9		8865.3

* Certain portion of this water will be utilised for forest and orchard raising, fisheries and aquaculture and riparian and ecological needs.
+ Due to high commitment to West Bengal there may be difficulty in meeting the M & I needs of Damodar and Barakar sub-basins.

Annex 2/6B

DETAILS OF GROUND WATER UTILISATION IN DIFFERENT RIVER BASINS OF BIHAR

Sl No	Name of Basin	M & I Uses		Irrigational Use		Balance		Total	
		quantity (MCM)	%	quantity (MCM)	%	quantity (MCM)	%	quantity (MCM)	%
North Bihar									
1	Ghaghra-Mahi-Western Gandak composite	299.0	15.00	687.0	34.44	1008.4	50.66	1994.4	100
2	Upper Eastern Gandak-Upper Burhi Gandak composite	472.0	15.00	524.0	16.66	2149.0	68.34	3145.0	100
3	Lower Eastern Gandak-Baya Lower Burhi Gandak composite	320.0	15.00	908.0	42.57	905.0	42.43	2133.0	100
4	Bagmati Adhwara	279.6	15.00	1358.0	72.85	226.4	12.15	1864.0	100
5	Kamla Balan	179.0	15.04	446.0	37.48	565.0	47.48	1190.0	100
6	Kosi	555.0	15.00	1644.0	44.43	1501.0	40.57	3700.0	100
7	Mahananda	347.0	15.00	1599.0	69.22	364.0	15.78	2310.0	100
	Total North Bihar	2451.6	-	7166.0	-	6718.8	-	16336.4	
8	Ganga Stem	234.0	15.00	1236.0	79.20	91.8	5.80	1561.8	100
	Central Bihar								
9	Karmnasa	248.7	15.00	503.0	30.33	906.8	54.67	1658.5	100
10	Sone & Kao-Gangi	376.0	15.00	760.0	30.30	1371.0	54.70	2507.0	100
11	Punpun	303.0	15.00	845.0	41.83	822.0	43.17	2020.0	100
12	Harohar	399.0	15.00	1977.0	74.30	284.0	10.70	2660.0	100
13	Kiul	64.0	15.02	234.0	54.93	128.0	30.05	426.0	100
14	Badua-Belharna	88.5	15.00	334.0	56.56	168.0	28.44	590.5	100
15	Bilasi-Chandan-Chir	134.0	15.00	526.0	59.32	233.0	25.68	893.0	100
	Total Central Bihar	1613.2		5179.0		3962.8		10755.0	
	South Bihar								
16	Gumani & Koa-Bhena	54.0	14.88	299.0	82.37	10.0	2.75	363.0	100
17	Mayurakshi & Others	67.0	15.00	324.0	72.80	54.0	12.20	445.0	100
18	Ajay	38.0	15.02	158.0	62.45	57.0	22.53	253.0	100
19	Sankh	48.0	15.05	163.0	51.10	108.0	33.85	319.0	100
20	South Koel	104.0	15.00	486.0	70.00	104.0	15.00	694.0	100
21	North Koel	102.0	15.00	534.0	78.50	44.0	6.50	680.0	100
22	Barakar	56.0	8.63	424.0	82.15	30.0	9.22	510.0	100
23	Damodar	176.0	24.41	500.0	60.35	45.0	6.24	721.0	100
24	Kharkai	73.0	30.00	14.7	6.20	154.3	63.80	242.0	100
25	Subernarekha	158.0	25.00	273.0	43.00	203.0	32.00	634.0	100
26	Small Streams Draining Independently outside the State	19.0	15.00	73.0	57.00	36.0	28.00	128.0	100
	Total South Bihar	895.0		3248.7		845.3		4989.0	
	Grand Total	5193.8		16829.7		11618.7		33642.2	

IRRIGATION POTENTIAL OF BIHAR

Unit : ha

Sl. No.	Name of the basin	Major & medium scheme				M I surface water scheme				M I ground water scheme				Total potential of MI schemes	Total potential of major & MI schemes
		Kharif	Rabi	H W & Annual	total	Kharif	Rabi	H W & Annual	Total	Rabi	H W & Annual	Total	Additional Kharif & HW		
North Bihar															
1	Ghaghra-Mahi-Western Gandak composite	314360	182900	89200	586460	19846	–	–	19846	77590	59480	137070	111124	268040	854500
2	Upper Estern Gandak-Lower Gurhi Gandak composite	286000	186550	106750	579300	63538	23429	–	86967	62000	553t5	117315	87714	291996	871296
3	Lower Eastern Gandak-Baya Lower Burhi Gandak composite	202990	144100	22940	370030	69690	15420	–	85110	94785	92455	187240	140000	412350	782380
4	Baghmati Adhwara	167800	44400	7700	219900	93200	15909	–	109109	164545	118284	282829	–	391938	611838
5	Kamla Balan	150320	96901	62700	309921	24000	5682	–	29682	47955	42495	90450	67143	187275	497196
6	Kosi	304700	269154	204186	778040	150923	25818	–	176741	145454	129846	275300	241143	693184	1471224
7	Mahananda	181692	84407	19785	285884	24462		–	24462	162203	138064	300267	–	324729	610613
	Total North Bihar	1607862	1008412	513261	3129535	445659	86258	–	531917	754532	635939	1390471	647124	2569512	5699047
8	Ganga Stem	46786	45488	19713	111987	34500		–	34500	88000	78812	166812	–	201312	313299
	Central Bihar														
9	Karmnasa	188853	150379	16258	355490	32000	8989	–	40989	51910	31264	83174	77714	201877	557367
10	Sone & Kao-Gangi D/S	299297	285335	39673	624305	26308	–	–	26308	26957	39510	66467	132286	225061	849366
	Composite U/S	13580	5560	650	19790	58115	–	–	58115	39318	7317	46635	118533	223283	243073
11	Punpun	305825	141550	15555	462930	88615	25000	–	113615	116739	39487	156226	–	269841	732771
12	Harohar	333324	39860	25870	399054	68000	7399	–	75399	317937	69217	387154	–	462553	861607
13	Kiul	55924	17705	73629	15538	4348	–	–	19886	26956	13631	40587	–	60473	134102
14	Badua-Belharna	64343	10308	74651	19833	3913	–	–	23746	48696	14667	63363	–	87109	161760
15	Bilasi-Chandan-Chir	109261	27438	5186	141885	39500	–	–	39500	83913	18667	102580	–	142080	283965
	Total Central Bihar	1370407	678135	103192	2151734	347909	49649	–	397558	712426	233760	946186	328533	1672277	3824011

Contd.

Unit : ha

Sl. No.	Name of the basin	Major & medium scheme				M I surface water scheme				M I ground water scheme				Total potential of MI schemes	Total potential of major & MI schemes
		Kharif	Rabi	H W & Annual	total	Kharif	Rabi	H W & Annual	Total	Rabi	H W & Annual	Total	Additional Kharif & HW		
	South Bihar														
16	Gumani & Koa-Bhena	53826	10095	140	64061	40833	10227	–	51060	35682	19586	55268	–	106328	170389
17	Mayurakshi & Others	88900	26790	960	116650	45833	10210	–	56040	24170	26000	50170	–	106210	222860
18	Ajay	91645	16497	–	108142	31385	6667	–	38052	17292	11538	28830	–	66882	175024
19	Sankh	56952	29159	9780	95891	39077	11364	–	50441	31591	2927	34518	–	84959	180850
20	South Koel	107355	43500	16150	167005	98308	22727	–	121035	89318	11341	100659	–	221694	388699
21	North Koel	150762	37715	–	188477	25231	–	–	25231	82045	21098	103143	–	128374	316851
22	Barakar	36153	13090	–	49243	16307	–	–	16307	62963	22237	85200	–	101507	150750
23	Damodar	65615	23150	–	88765	23540	–	–	23540	86100	22970	109070	–	132610	221375
24	Kharkai	107275	76866	21887	206028	7185	–	–	7185	1744	935	2679	–	9864	215892
25	Subernrekha	166433	82110	25849	274392	24462	7442	–	31904	35349	15714	51063	–	82967	357359
26	Small Streams Draining Independently outside States	8615	3644	720	12979	21692	11628	–	33320	8837	4730	13567	–	46887	59866
	Total South Bihar	933531	362616	75486	1371633	373850	80265	–	454115	475091	159076	634167	–	1088282	2459915
	Grand Total	3958586	2094651	711652	6764889	1201918	216172	–	1418090	2030049	1107587	3137636	975657	5531383	12296272

Annex 2/8

ESTIMATE OF FUTURE REQUIREMENT AND PRODUCTION OF FOODGRAIN BY 2025 AD

	Name of basin	Projected Population in Lakh	Foodgrain Requirement in LMT	Crop Coverage in Lha	Foodgrain Production in LMT	Remarks
	North Bihar					
1	Ghaghra-Mahi-Western Gandak composite	121.23	21.68	7.62	18.85	Foodgrain requirement has been assessed @ 490 gm per capita per day.
2	Eastern Upper Gandak-Upper Burhi Gandak composite	105.76	18.82	8.21	20.48	
3	Eastern lower Gandak-Baya-Lower Burhi Gandak composite	186.85	26.26	6.84	16.08	
4	Bagmati-Adhwara	113.90	20.37	7.02	18.29	
5	Kamla-Balan	79.80	14.27	4.81	11.36	
6	Kosi	137.11	24.52	12.57	31.36	
7	Mahananda	75.79	13.56	5.92	14.52	
	Total North Bihar	780.44	139.48	52.99	130.94	
8	Ganga Stem	101.13	18.09	4.44	10.36	
	Central Bihar					
9	Karmnasa	35.93	6.43	4.81	12.94	
10	Sone(Stem)-Kao Gangi Comp.	103.52	18.51	8.81	23.19	
11	Punpun	101.69	18.19	8.67	22.49	
12	Harohar	146.92	26.28	10.70	26.03	
13	Kiul	20.93	3.74	1.59	3.40	
14	Badua-Belharna	22.22	3.97	1.80	4.78	
15	Bilasi-Chandan-Chir	45.14	8.07	3.18	8.46	
	Total Central Bihar	476.35	85.19	39.56	101.29	
	South Bihar					
16	Gumani & Koa-Bhena	28.47	5.09	2.64	5.17	
17	Mayurakshi & Other	32.38	5.79	2.77	5.99	
18	Ajay	24.05	4.30	2.15	4.86	
19	Sankh	9.42	1.68	2.35	4.68	
20	South Koel	33.66	6.02	5.08	10.09	
21	North Koel	39.14	7.00	4.08	8.26	
22	Barakar	47.89	8.57	2.31	4.02	
23	Damodar	101.57	18.17	3.36	6.10	
24	Subernarekha	18.87	3.37	2.13	4.86	
25	Kharkai	63.37	11.33	4.30	8.60	
26	Small streams draining independently outside the State	6.75	1.21	0.82	1.58	
	Total South Bihar	405.57	72.53	31.99	64.21	
	Total for the State	1763.49	315.29	128.98	306.80	

INTRODUCTION OF MODIFIED SATTA SYSTEM (TOR 4)

34 The system of filing applications (Sattas) for water and issue of permits to release water in village channels should be continued/ reintroduced with clear demarcation of irrigation blocks for every village channel/ minor/ water course. This arrangement provides opportunities to the suppliers of water and the users to interact and know each-other's responsibilities and limitations. It helps to know in advance the requirement of water and, therefore, facilitates planning. In future, this may help to guide and control the cropping pattern in the command.

This is the only instrument to bind the farmers and control the patrols/ amins/ ziladars to satisfaction of both sides. The area of the irrigation block and the area for which Satta may be filed being known in advance, there will be less chance of malpractices, and if there be any, it will be detected more easily.

The plea that farmers do not file Sattas and keep on waiting for rains does not appear tenable. This might happen either due to loss of faith in reliability of supply of water in proper time and in proper quantity or due to ignorance and poverty of the farmers. If they come to know that irrigated agriculture will give them more than twice or thrice the produce which they might be getting on rain-based agriculture and they will have money to pay the water charges, they will surely file Sattas in time and take advantage of the same depending on reliability of the system. For this, proper education/agricultural extension work and arrangements for credit facilities are needed.

[Para 3.4.1]

35 Lack of faith in the reliability of the system to supply water in right time and in right quantity appears to be the greatest hurdle why farmers might be feeling hesitant to sign Sattas in time.

To increase the reliability of the system, following minimum measures are suggested for immediate consideration of the Government :

i The canal banks and the structures should be maintained in their original designed shape and size. Irrigation to the fields should be provided through outlets of village channels/ water courses and minors and not directly from the main and branch canals or even from distributaries as far as practicable. Unless this is done, water cannot be expected to reach the tail end of the canal. Rotational system of supply and warabandi are other measures which will have to be adopted to ensure reliability and equity of supply. Where feasible, enforcement of warabandi may ensure equity of supply amongst different farmers in the same outlet command.

ii Canal maintenance division may be divided into two groups. The first group may be assigned the work of maintenance and operation of the system upto distributaries to ensure the responsibility of assuring availability of water with appropriate heads at the head regulators of village channels/ minors and water courses which might be taking off from main and branch canals and distributaries. The other group should be responsible for maintenance and operation of village channels/ water courses/ minor and field channels. This group may be responsible for imparting irrigation in the fields and assessment of water rates also.

iii Where Command Area Development Agencies are already functioning, the divisions responsible for maintenance and operation of field channels/ village channels/ water courses/ minors, may be placed under the administrative control of CADA's.

The Commission has already made separate recommendations for restructuring of the CADAs,

for redefining their functions and for placing them under direct control of Water Resources Department.

iv Command Area Development approach should be adopted for on-farm development works in all remaining major and medium projects outside the present CADAs under direct control of Water Resources Department.

[Para 3.4.2]

36 The provision that 85 per cent of the farmers should sign the application (Satta) for kharif season lease may suitably be reduced, say to 51 per cent. The canal officers may be authorised to issue permits to open head regulators of village channels/ water course, minors even without waiting for requisite number of Sattas, if the condition of the fields/ crops so demands, and farmers should be continued to be persuaded to sign Sattas even after opening of the canals but well before the maturity of the crops. The defaulting farmers who utilised canal water without signing the Sattas may be required to pay enhanced penal water rates as might be decided by the government from time to time. This is considered necessary to induce them to sign Satta in time.

[Para 3.4.3]

37 The application (Satta) for kharif season lease, which has to be signed by the farmers, has a provision which reads as below :

"This sum will be payable of our requiring water or not". This proviso has proved a great deterrent and an instrument for vexing the farmers by the patrols/ amins. It is, therefore, felt that this sentence should be deleted and the assessing authorities should be sufficiently liberal to see that farmers are not unnecessarily harassed by charging for the land not actually irrigated though applied for in the Sattas.

[Para 3.4.4]

38 The institution of Lambardars should be reintroduced. The irrigators of a village channel/ minor/ water course may elect one or more Lambardars (in case irrigators are divided into groups) to represent them and guard their interests in irrigation management, assessment and collection of water rates and to discharge all the responsibilities, as defined in the Bihar Canal Irrigation Rules, framed under Bengal Irrigation Act, 1876.

The Lambardars should be paid suitable remuneration for their services in irrigation management as already provided in the Rules.

[Para 3.4.5]

39 Government minors, water courses and field channels should be declared as village channels under part V, section 46 to 73 of Bengal Irrigation Act, 1876 and their maintenance and operation should be regulated as such.

[Para 3.4.6]

40 With declaration of government minors, water courses and field channels as village channels, these may be turned over to WUAs, to be formed separately by the irrigators of separate channels, who should take up the responsibility of maintenance and operation of these channels in due course. Suitable rent may be fixed to be collected from the irrigators, alongwith the water rates, and the amount of rent so collected, may be made over to the Associations for maintenance and operation of these channels.

Even where WUAs are formed, the institution of Lambardars should not be done away with. The WUAs should be responsible for maintenance and operation of their channels and practice of warabandi in their areas, the Lambardars, who should be directly elected by the beneficiaries, should continue to discharge their duties/ responsibilities, as already provided in the existing rules.

In absence of WUAs the village channels could be turned over to any person or a group of persons who could be willing to become owners and undertake the operation and maintenance of the same (permissible under the said Act). Such owners also would be entitled to receive rent for maintenance and operation of their channels, which could be collected alongwith the water rates and paid to them.

[Para 3.4.7]

41 The Department should then apply most of its energy and resources to improved the condition of canals upto distributaries (as the channels below the distributaries may largely become the responsibility of the users or owners at their cost) and ensure the reliability of supply at the heads of minors and water courses converted into village channels.

In case of failure of WUAs or other owners of the village channels, the department could always maintain these channels at their cost (WUA's), for which there are ample provisions in the Bengal Irrigation Act, 1876 and Rules framed under it.

[Para 3.4.8]

42 Action should be taken to demarcate the Irrigation Blocks for each village channel/ water course/ minors and in each village by providing raised boundary on Block's periphery to facilitate proper use of canal water and filing Sattas etc. vide Rule 10 of the Bihar Canal Irrigation Rules.

[Para 3.4.9]

43 To ensure assured irrigation revenue and to reduce the quantum of annual repetitive Sudkar and measurement for assessing water charges under substituted Section 74 of the Act, the cultivators having long term leases may be persuaded to enter into permanent lease for levy of permanent kharif water rates. Such cultivators may be considered for granting relief, say upto 10 per cent to 15 per cent in rabi rates for growing irrigated rabi in the same area.

[Para 3.4.10]

44 Similarly, for the areas for which kharif water rates have been collected for atleast last four years, against kharif season leases (or even without Sattas in new projects), the cultivators may be persuaded to enter into permanent lease for levy of permanent kharif water rates with similar relief in rabi rates as mentioned in item No 10 above.

This process may be continued till the maximum possible kharif area (where kharif irrigation is stabilised) may get converted into permanent lease for collection of permanent kharif water rates.

[Para 3.4.11]

45 For the rest of the kharif areas, which may come under probable irrigable command, and for rabi and hot weather crops, the system of annual assessment may continue as usual.

[Para 3.4.12]

46 The canal officers are responsible for supply of irrigation water and for overall irrigation management.

The irrigators make use of water so supplied. Hence, the work of assessment can be best done only by the combined machinery and efforts of the canal officers and the irrigators, who may act through their representative, Lambardars, or Water Users' Associations. The logic of transferring the work of assessment to canal revenue Deputy Collector is therefore not very clear. Neither it has brought any improvement in the system. The situation has rather deteriorated beyond limit which will be evident from the progress of revenue collection B/4.

The Commission, therefore, is strongly of the view that work of assessment should revert back to the combined machinery of suppliers and users of water as was prevalent in the old Satta System.

The recommendation is in line with the recommendations of the Second Central Irrigation Commission, First Bihar State Irrigation Commission and the practices adopted in most of the states of India where situations are alike to those of ours.

[Para 3.4.13]

47 As far as collection of water rates is concerned, this State also should fall in line with Maharashtra and Punjab. In Maharashtra, Irrigation Department officials prepare list of farmers and associated areas cropwise to form the basis for charging but the collection is done by the revenue wing of the civil administration. In Punjab, where there is hundred per cent collection of water rates, the Patwari (village level official) is responsible for collection and is allowed to keep 3 per cent of the revenue as an incentive.

Accordingly, we should take advantage of the services of 'Anchaladhikaris' posted in the blocks and the 'Karmacharis' (village level officials) for collection of water rates. This may be done by declaring the Anchaladhikaris as canal revenue Deputy Collectors and augmenting their office establishment by contributing suitable number of revenue assistants and peons from WRD Department. In this arrangement the Karmacharis may collect the water rates also when they go for collection of land rent from the villagers. If this system is adopted, there will be scope for reducing expenditure on canal revenue establishment.

CADAs should make genuine efforts for formation and development of Water Users' Association. If such WUAs really develop in future as envisaged by the World Bank in their Irrigation Sector Review of India, they may take over the works of irrigation management, assessment and collection of water rates also. But till then the State has to manage with the age old age tried system with appropriate modifications as suggested above. However, for any system to succeed the canal discipline will have to be restored with suitable measures for its strict enforcement in future.

[Para 3.4.14]

RECOMMENDATIONS ON PRIORITIZATION OF TAL AREA SCHEMES

48 In the light of discussions contained in the main report on prioritisation of schemes of Mokama Group of Tal, the drainage effectiveness of the proposed five cuts are summarised as below:

The cut at Rukunpura may be operative only twice in 16 years, the cut at Rawaich may be operational only twice in 16 years, the cut at Ralley may be effective only once in 16 years, the cut at Kanhaipur may be operative only once in 16 years and the cut at Hemza may be operative only thrice in 16 years.

The above frequency may, however, be upset due to abnormal fluctuations in the levels of the river Ganga at the outfall points.

Subject to normal levels in the Ganga, none of the cuts are expected to be operative when the inflow in the Tal is lesser than 50.80 cm. The average monsoon inflow in the catchment. On the basis of records of the last 16 years, has been computed as 39.12 cm, which may mean that under average conditions, cuts may not be operative.

Under conditions described as above, there is practically no chance of draining the Tal for kharif irrigation as we have no means to lower the level of the river Ganga either at the cut points or at the outfall of the Harohar Kiul into the Ganga.

Rabi crops are already being grown in the major portion of the Tal areas if the Tal is drained by 15th of October. The available records from 1972 to 1991(17 years) indicate that:-

i Fatuha Tal, Bakhtiarpur Tal and Barh Tal were cleared by the 15th of October during all these 17 years.

ii More Tal got cleared by the 15th of October in 13 years out of 17 years of records.

iii Mokama Tal got cleared before 15th of October during 11 years out of 17 years.

iv Barahiya Tal got cleared during 12 years, before 15th of October out of 17 years of records.

v Singhaul Tal got cleared before 15th of October in 15 years out of 17 years of records.

The Rukunpura and Rawaich cuts are opposite to the Bakhtiarpur Tal. But Bakhtiarpur Tal and the Fatuha Tal which is above it and the Barh Tal which is below it have not suffered any delay in drainage in last 17 years. This also indicates the redundance of these two proposed cuts.

The Ralley and Kanhaipur cuts are in the More Tal. But these two cuts are likely to be effective only once in 16 years in case of maximum rainfall in the catchment of the Tal rivers.

Worst condition is of the Mokama and Barahiya Tals, which are not cleared in 6 and 5 years respectively, out of 17 years of records.

The Hemza cut, which is at the lowest point, can give relief to these Tals as well as to the More and Singhaul Tals. The Hemza cut is also likely to be operative thrice in 16 years.

The above studies indicate that if any cut has to taken up on trial basis, then it appears to be the Hemza cut. Any work of improvement in any drainage system should start from the lowest end. From this point of consideration also, the Hemza cut may be taken up first which may reduce

the water levels of Tal at all the cut points in the upstream also.

Between the proposed Hemza cut and Balguderghat bridge on the Harohar river there are seven bridges in Barahiya-Lakhisarai road with a linear waterway of about 250 m (820 ft). The approach channels from the Tal to these bridges and exit channels from these bridges to the Ganga have badly been encroached upon reducing the drainage efficiency of these bridges to practically nil. These encroachments should declared and bridge made functional to facilitate early clearance of the Tal area as soon as the Ganga levels fall.

However, the utility of upper cuts, such as at Kanhaipur may be examined by the department for providing flow irrigation by the Ganga water in the Tal area during kharif seasons of drought years. The kharif season (1992) faced a drought like situation and there was an opportunity to conduct actual field surveys to determine whether the Ganga waters can be utilised for providing kharif irrigation in a tangible area in the Tal and if so, the area of the Tal likely to be benefited can also be determined precisely to work out the cost benefit ratio. The possibility of siltation of the channel, from the Ganga to the cut point will, in such a case, need critical examination as frequency of drought is about once in 4 years and the channel may not be required to run for 4 to 5 years at a stretch.

49 Raising and strengthening of 74 Nos of zamindari embankments located in the Mokama Group of Tals

These zamindari bundhs appear to have been constructed to protect the kharif growing areas in the fringe of Tal from deep submergence. Such zamindari bundhs should be owned and maintained by the associations of beneficiaries. The Government may provide necessary technical and financial assistance as may be found practicable to maintain these bundhs in sound condition on clear stipulation that the primary responsibility of maintaining the bundhs be that of the beneficiaries.

50 Closure of 13 nos of culverts on Patna-Munger road and providing antiflood sluices in 2 nos of culverts only

These are very small works, and are not expected to affect the submergence of the Tal to any great extent, this way or that, in view of very large capacity of the Tal compared to the discharge through these culverts. These might be creating local drainage/flood problems for tackling of which these schemes, as proposed, may be constructed after thorough examination. However, the bridges between proposed Hemza cut site and Balgudarghat bridge should be made operational.

51 Though cultivation is done in almost entire area of the Tal, but for want of water, scientifically irrigated cultivation is not being practised. It is an irony that though the Tal is full of water during the monsoon season, the same in not available at the time of rabi cultivation in particular. It is, therefore, felt that the Government should consider the following suggestions to meet these exigencies:

i Feasibility of constructing adequate number of large sized tanks/ponds on higher patches in the Tal, to hold back as much water of the Tal as possible for use of rabi and hot weather irrigation, may be got examined and schemes found feasible be taken up,

ii The possibility of constructing a high level road, from west to east on the southern periphery of the Tal areas should be investigated and its execution be taken up if found economically and technically viable. This road would cross all the streams entering the Tal. Gated regulators cum bridge may be constructed at the crossings of the streams to hold back water behind the regulators forming ahars on the south/west of the road. This water could be utilised for irrigation during rabi/ hot weather season.

If, however, there are already such roads existing in the Tal areas crossing the rivers entering the Tal, the crest levels of these roads may be raised well above the submergence levels of the Tal and bridges at the crossing points of the rivers may be converted into gated weirs, to form ahars behind them where monsoon water could be retained for utilisation during rabi and hot weather. The Commission does not, however, feel optimistic about the usefulness of a high level west-east drainage canal, proposed in some reports to drain all the monsoon waters of rivers coming in the Tal from south to the river Kiul at a higher level to prevent their entry into the Tals. It is apprehended that this may amount to creation of another Tal above the present one, at a huge cost, wasting lot of cultivable land. This may also amount to violent intervention in the environment of the area and breaches of the northem bank of the proposed drainage canal (which cannot be completely ruled out) may simply be disastrous for the present Tal areas.

iii Possibility of constructing a barrage, across the Punpun, may be got examined, with canal taking off from its right bank, to provide irrigation in the Fatuha, Bakhtiarpur and Barh Tal.

iv All possible incentives may be given to the cultivators for development of private tubewells.

v As regards the proposal to provide irrigation in the Tal area either through a lift pump canal from the Ganga or through a string of State tubewells on the periphery of the Tal, the following points should receive serious consideration of the State Government before taking a final decision:-

(a) Large chunk of electrical energy needed in both the cases

(b) Large amount of subsidy involved in both the cases if they are owned and operated by the State Government

(c) Problem of their maintenance and operation and efficiency of performance in light of the experience in maintenance and operation of existing State tubewells

(d) Suitability or otherwise of open surface irrigation channels versus underground irrigation channels in view of submergence of the Tal area during monsoon season.

Note The Commission finalised its suggestion for fixing priorities for detailed planning and execution of Tal area schemes in its meeting held on 28.10.92. The report was submitted to the Government on 3.12.92. However, in the Commission's ninth meeting (18.12.92) Sri Nitish Kumar, Member of Parliament who is also a Member of the Commission requested to review the report on Mokama Tal on the basis of fresh data, particularly in respect of the proposed cuts which in his opinion are urgently necessary to effectively drain out the accumulated water in the tals. But with the data and records made available to the Commission, it was not possible to clearly determine to what extent these cuts could actually be effective. Additional fresh data to reconsider the issue could not be available to the Commission. In such a situation of uncertainties, even trial cuts have to be attempted one by one from the downstream. If the upstream cut is made first, quite possibly it may be found redundant after another cut in the downstream.

VOLUME IV

MEASURES FOR INCREASING THE EFFICIENCY AND EFFECTIVENESS OF PRESENT PROJECTS (TOR 6)

52 In order that a project may be able to perform at optimum level, it is necessary that the project be completed in all respects as envisaged in the sanctioned project report.

A Review Cell should be constituted in the monitoring wing to review each project by comparing actual constructions with the approved project provisions and list out the remaining works to be executed to make the projects fully functional.

[Para 6 (1)]

53 The post-facto evaluation reports reveal that earlier projects are deficient in vital control structures, such as cross regulators and escapes. It is, necessary to provide at least minimum number of cross regulators and escapes for optimum performance of the projects. The Review Cell of the monitoring wing should go into the details and list out the minimum number of cross and escape regulators to be provided on priority basis.

Possibilities of storing the water coming from the inlet channel in some ahars preferably behind the canal banks from where water could be released into the canals in a controlled manner for its appropriate utilisation should be explored.

[Para 6 (2)]

54 The construction of new minors/watercourses in completed projects should be taken up only after the existing main and branch canals, distributaries, minors and watercourses are thoroughly repaired, renovated and made fully functional.

The new watercourses should be planned and executed in consultation with the concerned farmers at their initiative.

The formation of Water Users Associations should be expedited to ward off the additional load of management of minors/watercourses at the Government cost. Attempt should be made to turn over even the existing minor/watercourses to the Water Users' Association as expeditiously as possible.

[Para 6 (3)]

55 Irrigable CCA of the completed projects should be reassessed on the basis of full supply levels of the canal systems in different reaches and critical levels of the fields to be irrigated, with the help of 0.3 m interval contours of the command area.

[Para 6 (4)]

56 Number of direct irrigation outlets will have to be rationalised as per actual requirement on the basis of topography of the land to be irrigated. Direct irrigation outlets should be provided from minors and water courses only as far as practicable. The outlets provided in the minors and water courses may remain even ungated. The minors and water courses should be run in rotation, with full supply discharge, so that all their outlets provide full discharge necessary for their command which will reduce the tendency of the farmers to interfere with the working of the system.

[Para 6 (5)]

57 The WRD should consider to have a separate hydel wing of its own to generate power from the canal falls and utilise the same for conjunctive use of ground water in the command.

Attempt should be made for integrated operation of old and new ahars with the canal system so that when there is excess water available in the rivers/canals this could be stored in the ahars for utilisation later on.

[Para 6 (6)]

58 Weirs utilising the run of the rivers for providing irrigation in their commands should preferably be backed up by reservoirs wherever feasible. Reservoirs should be planned on the basis of 50% dependable yield of the stream.

Weirs with falling shutters which have back-up reservoirs should be considered for conversion into/replacement by new barrages in due course.

Mechanical equipments may be provided at the weir sites which could move on the downstream floor of the weirs and lift the shutters to bring them in position in shortest possible time cutting down the period of dislocation of irrigation.

For easing the problem of excessive silt deposition in the pond, provision of river sluice by the side of the divide wall, wherever feasible, should be considered.

[Para 6 (7)]

59 Provision of annual OMR fund should be as per actual requirement to be determined on the basis of actual ground survey to be carried out at the end of the rainy season every year. OMR provision should be the first charge on the irrigation allotment to the Department so that the vital assets created so far may not get destroyed affecting the food production of the State. To ensure judicious expenditure of the allotted amount, fund for maintenance works should be allotted workwise and separate from regular and work-charged establishments. Fund for maintenance/ replacement of damaged gates should receive special attention.

[Para 6 (8)]

60 Proposals and estimates for modernisation/restoration /remodelling of old schemes which are not giving the desired benefits should be prepared in different sections and priority as indicated below:

i Special repairs to the structures which might be on the verge of collapse.

ii Earth work in banks of canals in order to bring them in their designed geometrical shape and size.

iii Repairs and remodelling of the existing structures wherever needed.

iv Construction of additional cross-regulators and end escapes.

v Construction of other additional structures whenever needed to run the existing system in systematic and satisfactory manner.

vi Development of additional minor system wherever there may be such demands by the beneficiaries.

[Para 6 (8)]

61 The following steps should be taken to bring about around improvement in irrigation services being rendered:

i Minors and watercourses may be declared as village channels as conceptuatised in the Bengal Irrigation Act, 1876.

ii Appropriate action may be initiated for formation of Water Users' Associations.

iii Till the formation of Water Users' Associations and their becoming financially self-sufficient the OMR allotment for minors and watercourses should be made separately which may get progressively reduced as the Associations develop their own financial capability to maintain and preserve them.

[Para 6 (9)]

62 Command Area Development approach should be adopted in all completed major and medium irrigation projects. Small Area Development Agencies under direct control of the WRD for OFD works in the commands of medium projects should be created.

The CADAs inter-alia, will have to take initiative for formation and training of the WUAs.

[Para 6 (10)]

63 Satta System as modified by this Commission should be introduced in all the completed projects alongwith the introduction of the institution of Lambardars.

Assessment of canal water rates should revert back to the engineering divisions responsible for supplying water to the farmers. Collection of water rate may be done through the Anchaladhikaries posted in Blocks who may be declared as canal officers for the purpose.

[Para 6 (11)]

64 System should be developed for farmers to raise paddy seedlings well in advance by the help of tubewells/tanks so that they are ready for transplantation as soon as the canals are opened.

The farmers should be given all possible incentives to develop their own tubewells/tanks for raising seedlings and to supplement irrigation in case of scanty supply from the canals.

[Para 6 (12)]

65 Dates of opening and closing of the canals should be permanently fixed with appropriate revision, wherever necessary, in consultation with the CADA and Agriculture Department. Variation in these dates should take place only with the concurrence of the officers of the WRD, CADA and Agriculture Department at the level of Chief Engineer with advance intimation to the Gram panchayats and Water Users' Associations concerned.

[Para 6 (14)]

66 A regulation manual and operating rules for reservoirs, weirs/barrages and the canals should be developed separately for each project on the basis of experiences gathered in their operation so far.

[Para 6 (15)]

67 Records of flows at different control points of the canal system which has suffered neglect should be maintained. Actual delta achieved should be worked out at the end of every crop season for every sub-system and this should be compared with the designed delta to ascertain the efficiency of the system and to take corrective measures, wherever necessary. The canal officers should ensure proper maintenance of all other records as stipulated in rules framed under the Bengal Irrigation Act, 1876.

[Para 6 (16)]

68 Govemment may consider to create appropriate machinery with adequate powers for protection of the canal systems and strict enforcement of canal discipline amongst all concerned.

69 A reliable communication system consisting of good service roads and wireless/telephones connecting the control points for operation as well as surveillance of the canal systems should be provided as soon as possible.

[Para 6 (17)]

70 The Monitoring Wing of the WRD should be suitably strengthened to monitor adequacy, timeliness and equity of water supply in different projects and in their sub-systems and should be in a position to suggest steps which should be taken to overcome the difficulties experienced. It should also collect information at appropriate intervals about the views and suggestions of the irrigators on the performance of the canal supplies to incorporate appropriate modification in working irrigation schedule.

[Para 6 (18)]

VOLUME V

FLOOD AND DRAINAGE PROBLEMS DF BIHAR AND THEIR REMEDIAL MEASURES (TDR 8)

71 State Government should take necessary action to prepare basinwise maps, showing the areas prone to flood to find out areas in each basin as well as the State as a whole, and flood prone area maps for floods of different frequencies, on the basis of historical records should be prepared without any further loss of time on priority.

(Para 3.5.5)

72 The anti-erosion works should normally be taken up only for protection of towns, industrial areas, group of thickly populated 'abadis', railway lines and roads where relocation is not possible on socio-economical grounds. These works should not be taken up for protection of agricultural areas where assets protected may not justify the cost. However, the areas of strategic importance and those where the territory of the State is involved, will have to be protected on priority basis.

It is further suggested that before taking up anti-erosion works at certain vulnerable and inescapable locations, it would be desirable to have the hydraulic model studies of the affected reach of the river carried out to find out its necessity and to finalise the type and design of such works as well as to locate the adverse effects and plan appropriate measures for the same in its entirety.

(Para 4.2.2.8
Para 7.3.6)

73 Realistic evaluation of flood damage river basin/sub-basinwise should be carried out every year under the following three separately identified categories-

i unprotected areas,

ii protected areas due to failure of protection works, and

iii areas situated between the embankments and the river.

The extent of area affected by drainage congestion in the protected and unprotected area should be indicated separately so as to distinguish between the damages caused by floods and by drainage congestions.

(Para 5.1.4)

74 It is considered desirable and in public interest to get the existing zamindari embankments, lying unattended and languishing resulting in flood damages to the so called protected areas, carefully reviewed on the lines of the suggestions of the RBA and decisions of the GOI on the same. This needs to be looked into on priority to reduce the damages caused by floods due to their non-functioning in desired manner.

(Para 6.1.3.4)

75 The comprehensive approach to the problem of floods, should form part of the overall comprehensive approach for obtaining the best possible utilisation of available land and water resources for optimum production, on a sustained long term basis, preserving the ecological balance and enhancing the environmental quality and minimising loss of life and property by either shortages or surplus of water i.e. by droughts or floods and to achieve this, following points are considered important -

i Planning should be basin/sub-basinwise.

ii Master Plans for flood management should be drawn up.

iii Measures for conservation and utilisation of water resources for multiple benefits should receive due emphasis.

iv Non-physical measures such as regulation of development in the flood plains, flood forecasting and warning, evacuation of the population to flood-proof shelters and other disaster preparedness and rescue operation plans are very important.

v The execution of the comprehensive plan for any basin or sub-basin should be taken up in phased manner.

(Para 7.1.2)

76 Reservoirs are no doubt a very dependable measure which by itself or in combination with other measures can mitigate the flood problem of a river basin considerably. It is, therefore, suggested that the reservoirs if found technically and economically feasible must be considered as an important constituent in any package of measures for flood management. Suitable sites for reservoirs in the case of North Bihar rivers are available only in Nepalese territory. The matter should be pursued vigorously with the GOI for securing Nepal's cooperation in construction of such reservoirs.

(Para 7.3.1)

77 It is suggested that all low lying zones in the old Kosi dhars which can be filled with silt being carried every flood season should be identified through detail survey. Such identified low lying pockets will have to be embanked to receive the flood at higher stages and connected to the river through link channels passing through low lying alignment with a regulator at its head located in the existing flood embankment on the main river.

(Para 7.3.2)

It is suggested that low lying pockets which can be used as detention basins in different flood prone river basins of Bihar may be investigated in detail and taken up as a flood management scheme in the basin where natural conditions permit. Use of such depressions for moderating high flood also implies that restriction must be imposed on high risk investment in such areas.

(Para 7.3.3)

78 It is suggested that the gaps in the existing embankments through which the flooding takes place in the protected area should be identified and filled up on priority basis within the shortest possible time. Similarly all efforts have to be made to extend the existing embankments on the rivers Bagmati, Kamla-Balan, Bhutahi-Balan etc. into the Nepalese territory and to anchor these with high ground to make them effective.

(Para 7.3.4)

79 It is desirable that all schemes for drainage improvement in the basin, which are lingering since long without accrual of any benefit out of the investments made, should be reviewed on priority basis and completed, if found useful on such review, as early as possible to realise full benefits. It is considered necessary to carry out post-facto evaluation studies of a few completed drainage schemes in order to find out their effectiveness and the extent to which these are serving the

desired purpose and if any modification is considered necessary at this stage to make these more effective. Further drainage schemes should be planned, designed and executed only after carefully assessing the results of the post-facto evaluation studies of completed drainage schemes in order to avoid past mistakes, if any.

The measures for removal of drainage congestion should be planned and executed in a coordinated manner, starting from the downstream end. Measures for irrigation and drainage should be fully integrated to provide maximum benefit from irrigated agriculture.

Requirement of extra waterways in the road and rail bridges for removal of drainage congestions as indicated in basinwise reports should be investigated in detail and executed according to requirement as quickly as possible. Drainage congestions at the crossing of two roads for want of suitable waterway near the junction need to be identified and suitable measures taken to avoid such situation.

Certain low lying pockets in the deepest portion of the 'Chaurs' or local depressions may be delineated on the village maps and developed for aquaculture and pisciculture as the case may be. Draining such low pockets by pumping is not considered economically viable.

(Para 7.3.5)
(Para 8.4.5)

80 Soil conservation measures have been recommended as a useful complement to other measures in the basinwise reports. It is suggested that the soil conservation work in different flood prone river system of Bihar be properly evaluated and the remaining works required to be implemented for delivering the intended benefits, should be formulated and completed on a time bound programme.

(Para 7.3.7)
(Para 8.3)

81 A systematic survey and investigation of the existing embankments of the river and its tributaries should be carried out every year after the flood season and encroachment, if any, in the free board in any portion should be made good by raising the height of embankments correspondingly. Suitable protection works should be provided in the portion where the active river channel is flowing very close to the toe of the embankment and river training works to hold the river in order to keep the flowing channel away from the embankment should be carried out on the basis of the hydraulic model studies. In the portion where the embankments have been eroded or are likely to be eroded, suitable retired embankment should be constructed to prevent flooding of the area already protected by the embankments.

(Para 7.3.8)

82 Occupation of embankments and the acquired lands by the flood affected people should be got vacated effectively to avert any danger or risk to the flood management embankments and to the people living in the protected areas. Raised platforms above the highest flood level may be constructed, in areas liable to inundation, near villages on Government or acquired lands. Such platforms should preferably be connected with all weather roads and should also be provided with necessary facilities for warehousing, community living, sanitary and potable water supply installation, space for keeping cattle and storing fodder, telecommunication facilities etc., in order to obviate likely inconveniences to the people residing on such platforms during floods.

(Para 7.3.9)

83 Contour maps of the flood prone areas of the State to a scale of 1:15,000 with contour interval of 0.3 meter should be procured for implementation of flood plain zoning measures. Flood risk maps should be prepared by carrying out necessary hydrological analysis of the historical data and further hydraulic computations to identify areas prone to flood for different frequencies of flood such as 100 years, 50 years and 25 years. Similar risk maps for the submersion caused due to drainage congestion as a result of water level likely to attain, corresponding to a 50 years and 25 years rainfall will also have to be prepared. Help of sattelite imageries may be taken for preparation of such maps.

(Para 7.4.1)

84 On receipt of the forecast, its dissemination to the local population in terms of likely depth of inundation and its duration in the area by the administrative authorities is very important so that affected population, cattle, movable properties etc., are evacuated before the area gets submerged by flood water which would cause damage. For this, a network of wireless stations and telephone system are necessary in the basin near critical/vulnerable reaches of embankments and towns etc., specially where other means of communication are not dependable or adequate. Flood warning to smaller areas may be conveyed through public address system or by beat of drums. Specific advice should be given to the people regarding evacuating the areas likely to be affected and also about the locations which could be considered safe for the level indicated in the flood forecasts.

(Para 7.4.2)

85 The State Government should ensure that all routine exercises and necessary drills for disaster management are carried out systematically before every flood season and departmental instructions, manuals and rules in this regard should be widely circulated so as to make these available to all concerned. Such training programme and exercises should be regularly held to inculcate a sense of preparedness among the officials.

(Para 7.4.3)

86 The design criteria adopted for planning of drainage schemes should cater for conditions that occur in most of the years and not for storms of rare occurrence. "Guidelines for Planning and Design of Surface Drains " (IS 8835-1978) may be followed in the light of local factors and design criteria laid-down by the State Government for all new schemes formulated in future. A review of all the schemes under construction should also be made in the light of the aforesaid guidelines and revision, if required, carried out in the project proposals.

(Para 8.4.3)

87 Detailed studies should be carried out to find out the effectiveness and adequacy or otherwise of the existing sluices in the embankments and remedial measures be taken on priority basis to make them function properly as and when necessary. Proper functioning of the existing sluices should be ensured in the first instance as early as possible as this itself is likely to help in removal of drainage congestion to a large extent. Construction of drainage channel parallel to the embankment and joined with the river on the downstream will be useful in certain cases depending upon the local conditions. Pumping could also be a solution but this is generally too expensive.

(Para 8.4.4)

88 While planning flood management schemes (or any water resources scheme) it is necessary to study the pros and cons of any environmental changes likely to be brought about and suitable remedial measures for reducing adverse effects, if considered necessary, should be included as

a part of the project.

(Para 8.5)

89 The following recommendations made by the Working Group on Flood Management for the Eighth Five Year Plan (1990-95) for establishing and developing a proper data base are recommended for acceptance and further necessary actions accordingly by the State Government:

"The Central and State Governments should allocate sufficient funds under Plan head for establishing data collection units with the primary objective of collection of data/information on a continuing basis, so that it will be useful for the future planners. There should be free exchange of data between the States concerned regarding repercussions of contemplated flood schemes in upper area, lower areas and on opposite banks while planning flood management schemes on inter-state rivers or near the border. It would be necessary to provide adequate funds for running and maintenance of such units under Non-Plan head. The Central Water Commission should coordinate the planning of such measures in the States without further loss of time and the States should come forward to implement these activities speedily. It is suggested that provisions made for the purpose and the expenditure thereon each year may be centrally reviewed at the time of finalising the Annual Plans to enable establishment of much needed data base for future planners". (Para 8.6.3)

90 A special estimate under "A – Preliminary" should be prepared for investigations of new schemes and funds provided. If the scheme is not found viable, no further action is to be taken. If the scheme is considered viable and accepted for execution the expenditure should be included in the proforma in the main estimate of the project so as to reflect the actual cost.

While investigations under "A – Preliminary", are considered enough upto the stage of administrative approval, detail investigations should be carried out before finalising the working estimates for obtaining technical sanctions in order to make these estimates and plans realistic to the maximum possible extent.

(Para 8.8.1)

91 It is desirable that funds in flood sector are allocated according to the priorities fixed in the Master Plan of the basin/sub-basin. It is likely that during every flood season emergent situation may arise for which ameliorative action would have to be taken. Some of these situation may require formulation of schemes which, barring exceptional cases, should be ranked lower in priority than the continuing schemes.

(Para 8.9.2)

92 Allocation of fund for flood management schemes should be carefully made in order to complete maximum number of continuing schemes within the shortest possible time to avoid cost and time over-run. The funds should also be provided in the manner so as to execute works in stages from upstream end to provide early benefits from the investments made.

(Para 8.9.1)

93 The assets already created in the shape of flood management and drainage structures should be properly maintained to protect them from any damage and consequent deterioration in the long run for which sufficient funds should be made available from Non-Plan head of the State Budget.

(Para 9.2.9)

94 Suitable measures should be taken by the State Government for maintenance of structural and non-structural flood management measures as suggested by the Working Group of the Planning Commission on flood management for the 8th Five Year Plan (1990-95) at the earliest so that the assets created with huge investments are not allowed to deteriorate and disintegrate. The WRD should prepare an inventory of flood management and drainage improvement works and work out the requirement of funds for annual maintenance during the initial period of three to five years and also for subsequent years after these works have been maintained properly and adequately. Funds for maintenance of assets created for flood management and drainage improvement works in the State should be made available in accordance with the requirement thus worked out in order to ensure that the unrepaired and unattended flood management works do not pose serious danger to the protected area.

(Para 9.4)

95 The State Government should not only provide adequate funds in the Non-plan budget for maintenance of the assets created already but should also streamline the procedure for allotment of funds as per budget provision well in advance of the flood season, i.e. in the month of April itself, to ensure timely execution of the necessary repair works before the onset of the monsoon. Bulk of the funds have to be provided during first four months of the financial year so as to complete all the required repairs before the onset of floods. Arrangements should be made to ensure that the funds provided in the budget under Non-Plan head for Flood Control do not lapse at the end of financial year (March) but are allowed to be spent till the end of the working season i.e. June.

(Para 9.5)

96 In order to overcome problems of delay in land acquisition the possibility of adopting the advance payment of 80 per cent of compensation, as is being done in the States of Maharashtra and Gujarat, should be considered and if found suitable, be adopted. This will induce the owners of the land to permit construction of flood management works on their lands pending final award of compensation.

(Para 11.2.1)

97 Strict regulations of land use in flood zones and drainage channels are very essential to reduce the flood damages in real terms and, therefore, it is recommended that if the existing legislation allows, flood plain management measures should be strictly enforced under the existing laws and if existing laws do not enable enforcing such measures, suitable legislation should be undertaken. Pending such legislation which is likely to take sometime, flood plain management may be enforced through executive orders. To start with, this work should be taken up on priority, in first phase, for the areas which are not protected from floods and drainage congestions at present.

(Para 11.5.3)

98 Works of flood protection and drainage improvement affect the life of the beneficiaries and, therefore, such local people should be involved to a reasonable extent in the formulation and execution of schemes. Some of the items of participation could be extremely useful as soil conservation, digging of drainage channels, patrolling and watch on embankments, clearance of vegetations on river banks, removal of encroachments etc. It would also be useful if the local population is made aware of the characteristics of the streams and the flood that may affect their life. They could also be trained on measures of flood fighting, survival and retrieval, as also in measures for adjustment to floods.

(Para 4.6.2)

POLICIES AND PROGRAMME OF WATER RESOURCES DEVELOPMENT AND MANAGEMENT (TOR 1)

99 Once a project is taken up it should be completed expeditiously by providing earmarked fund for the same. Priority should by given to the completion of the ongoing projects and no fund should be allocated to the new schemes at the cost of the ongoing ones.

Once the project is completed it should be maintained properly and adequately in order that assets created at huge investments do not degenerate. Provision of adequate fund for this purpose should be ensured in Non-Plan budget. It should also be ensured that only such projects are taken for execution which could be properly maintained.

100 For improvement in the drought prone areas, methods of soil-moisture conservation, water harvesting practices, minimising evaporation losses, development of ground water potential and trans-valley transfer of water should be adopted.

101 A basinwise perspective plan for the creation and development of the ultimate potential should be prepared.

102 Before taking up construction of a project with external aid, an indepth analysis of its mechanism and benefits should be made, taking into account the repayment of the external debt alongwith the interest charges.

103 It is imperative for the Government to suitably reorient its planning, method of funding, contracting procedures, disposal of litigation relating to works contract and land acquisition and early clearance of the schemes which are beset with numerous deficiencies.

Instances have come to light that a project was sanctioned and construction initiated. After some time the project could not proceed due to some reason or the other but the construction organisation continued to be maintained for a very long time resulting in a large debit to the project estimate without any physical achievement. Masan and Bagmati irrigation project are such examples. This laid not only to improper expenditure but a disrepute of the State as it gives impression to the general public that a huge amount has been spent or swindled without doing any physical works. Such repetition should be avoided by necessary safeguards.

104 Sufficient hydrometeorological stations should be established in all river basins irrespective of the situation whether any project is coming up in the basin in near future or not.

It is necessary to establish a standardised state information system with a network of data banks and data bases, integrating and strengthening the existing central and state level agencies and improving the quality of data and the processing capabilities. There will have to be free exchange of data among the various agencies.

The proposed Hydrometeorology Wing should be strengthened with suitable, experienced and trained qualified personnel for observation, collection and processing of hydrological, meteorological and agronomical data. Water year books of each river basin should be published annually.

Basinwise planning and development of water resources should be done for the overall development of the basin.

While formulating schemes at micro level, views of the beneficiaries/Panchayti Raj bodies should be given due consideration as far as practicable.

105 Emphasis should be given to carrying out agro-meteorological studies for finding out correct crop water requirement.

To have a proper knowledge of water requirement of crops under varied soils and to raise crop productivity, detailed soil survey is considered essential. The National Bureau of Soil Survey and Land Use Planning of GOI have already conducted detailed soil survey delineating 175 soil series in Bihar. This should be utilised for classifying land capability and land irrigability of the State.

106 Construction, maintenance and operation of minors, water courses and field channels should be entrusted to the beneficiaries or the Water Users' Association by making them actual owners of the micro system. Farmers should be involved progressively in various aspects of management of irrigation systems particularly in operation, water distribution, maintenance and collection of water rates. Voluntary agencies should be encouraged to educate the farmers in efficient water use and water management.

107 On-farm development should be given top priority also in areas not covered by CADA so that full benefit is derived from the project without loss of time.

108 Environmental impact assessment of irrigation/flood management projects should be done during the operation stage and care should be taken to maintain the ecological balance.

109 In North Bihar rivers, bandalling should be tried for dry weather channelisation as an alternative to as well complementary to the river training works. Research should be carried out for finding economical and cost effective replacement of costly boulders and wire crates in river training works.

110 Soil conservation measures which are essential for sediment control and management in the catchment should be implemented.

111 The Bagmati irrigation and flood control project under execution should be reviewed and a decision taken immediately for execution or otherwise for existing sanctioned projects on the basis of past experience. Dispersal of flood waters through the various abandoned channels should be considered.

112 The canal network, both existing and proposed, should be critically reviewed from the drainage angle. No new canals should be constructed without ensuring satisfactory flood protection and drainage in the command area.

113 The rivers flowing through Nepal and India, drain through Eastern UP, North Bihar and North Bengal. The problems these region face are common not only because the international implication or ramification is similar but also because identical issues are involved. Such being the case, only a regional planning approach for flood control, irrigation and ground water exploitation in which the planning horizon will encompass the Indian as well as the Nepalese territory could yield tangible results.

114 In water deficient areas the policy of irrigation management should be so oriented as to cover the largest possible area with available water to spread benefits to the largest possible population.

115 Modernisation and rehabilitation of the existing canals and structures, to enhance their capacity and efficiency, should be given priority over new projects.

116 Artificial recharge to augment the ground water reserve should be resorted to wherever required and feasible.

An act to regulate the exploitation of ground water reserve of different aquifers should be made.

117 Stress should be given to maintain water quality and minimise the impact of industrial pollutants and use of pesticides on water.

Recycling of water in industrial application should be promoted to reduce its consumptive use.

118 Water harvesting tanks in plateau and sub-plateau region of the State should be constructed and the existing tanks should be deepened to hold more water.

Large-diameter surface wells should be constructed to supply water specially for domestic and other uses in rural areas of hilly regions.

119 Dry farming and horticulture should be encouraged along with commercial plantation in uplands of plateau and sub-plateau regions.

VOLUME VI (PART II)

REVIEW OF INTERSTATE AGREEMENTS AND SUGGESTIONS (TOR 3)

120 The water resource of an interstate basin should be treated as common property of all the co-basin states. Comprehensive and integrated planning for development of the entire basin/region should be prepared and requirement of the different parts be assessed on this basis. Existing authorised uses in the river basin should be fully protected. Unified view of the benefits to accrue through the projects should be taken in account. Costs of storage and operation & maintenance of common structures should be shared in accordance with the benefits received by each co-basin.

121 The agreements with West Bengal with regard to sharing of waters of Damodar and Mayurakshi-Sidheshwari-Noon Beel basins should be reviewed and a settlement should be brought about after due negotiation to retrieve Bihar's legitimate share of water of the basins.

122 Fresh agreements with HMG Nepal should be entered into through GOI for use of waters of North Bihar rivers for irrigation, flood control and power through multipurpose projects for overall development of North Bihar.

123 Suitable multidisciplinary team of experts should examine the draft before conclusion of any interstate agreement. Interbasin transfers should be agreed upon only after fulfilling the overall requirements of the parent basin. This should take care of future requirement also. Allocation should be made on the basis of utilisable quantity of water and not on the basis of available water.

Not only accurate assessment of utilisable water availability should be made before entering into any agreement but in a large basin, sub-basinwise distribution should also be indicated to avoid any dispute in future. The release pattern from control structures must be decided at the time of the agreement itself.

124 Guidelines for implementation of the agreement should be a part of the agreement. Time limit schedule for fulfilment of various clauses in the agreement should be stipulated in the agreement itself.

There should be provision for joint operation and maintenance of common control structures for safeguarding the interests of co-basin states.

The interstate agreement should be entered into with the proviso for ratification by concerned State Legislature before implementation.

Specific provisions should be made to safeguard against the violation of the agreement by any party. There should be provision for arbitration for settling disputes between the parties due to disagreement on any issue relating to the agreement in which the mode of appointment of the arbitrator should also be clearly spelt out.

125 The design of various components of common interests, covered by the agreement, should be finalised with the consent of co-basin states.

126 A separate cell in the Water Resources Department to exercise constant watch on the implementation of agreements should be formed.

VOLUME VI (PART III)

STREAMLINING OF ORGANISATIONAL STRUCTURE (TOR 5)

127 Functional restructuring of the department right from the Secretariat to the fields in conformity with the latest scientific management principles, may ensure appropriate emphasis on different activities with placement of right type of personnel on right jobs. This seems necessary to upgrade the overall performance of the department.

[Para 2.9]

It is, therefore, suggested that the WRD should be re-organised in three different wings, each headed by an Engineer-in-chief as indicated below:

a Water Management and Utilisation Wing

b River Training and Flood Management Wing

c Investigation, Planning and Project Construction Wing

[Para 3.4]

128 The senior most Engineer-in-Chief (Chairman of the Committee of Engineers-in-Chief) should be given effective control over the amalgamated office of the Secretary and the HOD. Primary function of the Secretary is to render advice to the Minister on policy matters. The responsibility of their execution/implementation rests with the HOD. In order that he may truly be able to discharge his obligations in the desired manner, it seems necessary that he should have full control over all the officers and staff of all categories in the amalgamated Secretariat office. To ensure this, annual CCR of all categories of officers and the staff should be routed through the HOD. The CCR of the Engineers-in-Chief should be written by the Minister himself.

[Para 3.3]

129 The Water Management and Utilisation Wing should form the main frame of the department. Therefore, this wing should be under the direct control of the senior most Engineer-in-Chief who may be the Chairman of the Committee of Engineers-in-Chief acting as the technical Head of Department as well.

[Para 3.7.1]

130 At the level of Assistant Engineer directly recruited officers should be placed in various wings of the department so that they may gain experience of works of all the wings. The department should keep a watch on their performance and aptitude while they are working in various wings.

On the basis of their performance and aptitude the personnel management wing of the department should prepare pannels of engineers suitable for each wing and promotion to the post of executive engineer in different wings be made on the basis of their expertise. Design, research and training wing of the department should be given better opportunity for promotion by making available various scale of pay as is available in teaching profession under the Health Department of GOB. Engineers with Master or higher degree may be made eligible for even out of turn promotion in design, research and training cadre on the basis of their seniority-cum-merit and past performance.

[Para 3.4]

131 Transfer of permanent Divisions/Sub-divisions lock, stock and barrel to new place, with disregard to set departmental rules for closing, transfer and opening of Divisions/ Sub-divisions, should be avoided as far as possible in future.

[Para 2.8.10]

132 The post of FA-cum-CAO should be filled up by an officer not below the rank of Senior DAG, drawn from Indian Audit and Accounts Service or Defence Audit and Accounts Service, who should render financial advice to the Government in the department. The present post of Joint Financial Advisor cum Chief Accounts Officer may be abolished.

The system of pre-check should be abolished and the system of post-check introduced. The accounts wing under the FA-cum-CAO should share the responsibility of compilation of divisional accounts, disposal of audit objections and updating of various accounts. The accounts officers should be entrusted with the task of compilation of zonewise accounts and submission to the FA-cum-CAO in the Secretariat for compilation of the same at the State level and submission to the AG. The accounts should be maintained in the office of the Chief Accounts Officer in a manner such that project/scheme wise uptodate expenditure is readily available in the department. The accuracy of expenditure figures should be the responsibility of the Office of the Chief Accounts Officer.

[Para 3.5]

133 The Bihar State Construction Corporation should be allotted work on turn-key basis with transfer of budget to them in proportion to the progress of work and they should be asked to execute the works departmentally and should employ petty contractors for supply of labours only. They should have their own cadre of engineers also as other staff. If these conditions are not enforced by the State Government for some reasons or other then in our opinion it would be worthwhile disbanding this Corporation.

[Para 2.8.8]

134 As separate Minor Irrigation Department has been in existence since long, it has become a historical event and it would be very difficult to completely amalgamate this department with the main WRD. As such, it is suggested that the Minor Irrigation Department may remain a separate department for construction of minor irrigation schemes but there should be full co-ordination between the two departments at the stages of investigation and planning and water management. While preparing master plans for a river basin the investigation and planning wing of the WRD should prepare indicative minor irrigation schemes to be investigated further in detail and constructed by the Minor Irrigation Department.

[Para 3.7]

135 Chief Engineer, Monitoring and Evaluation and the SE, Procurement, though under general

administrative control of the Engineer-in-Chief (WMU), shall concurrently work for other wings of the department as well and for matters relating to those wings, they shall act as per directions and instructions of the Engineers-in-Chief concerned.

[Para 3.8]

136 The Command Area Development Agencies may be brought under the administrative control of the Water Resources Department. It would be desirable to attach the CADAs with WMU wing of the department with a separate Additional Secretary and other staff to deal with CADA matters at the Secretariat level.

[Para 3.9]

137 The Central Design Organisation should continue to work in pursuit of higher knowledge to bring refinements into design by incorporating latest concepts, theories and techniques in design of various hydraulic and other structures. The Chief Engineer CDO should perform the functions of the Chief Engineer PP Cell also for which his organisation is better equipped. It should take additional assignment of project preparation and getting clearance of the same, where needed, from CWC. It should develop an up-to-date technical library and organise a documentation wing where authentic history of the projects, copies of project reports, past and present criteria of various designs, copies of technical reports, copies of recommendations of various Committees/ Commissions relating to the field of irrigation, flood control, agriculture and management practices and copies of Acts, rules and regulations etc., related to them should be readily available.

[Para 3.11.(iii)]

138 The Chief Engineer PP Cell may be redesignated as Chief Engineer, Hydrometeorology, with a suitable organisation under him for observation, collection, analysis, compilation and publication of all hydrometeorological data pertaining to different river basins of the State on a regular and continuing basis.

[Para 3.11(i)]

139 The present Chief Engineer, Master Planning, Patna may be renamed as Chief Engineer, Investigation and Planning. He should be responsible for investigation, planning and project preparation for all future major and medium irrigation schemes, modernisation of existing canal systems, flood control and drainage schemes. He should also prepare indicative schemes for minor irrigation. The project reports prepared by him should be throughly examined and checked in the CDO before clearance and approval of the State Government. For cases where clearance of CWC is also needed it should be the responsibility of the Chief Engineer, CDO, to obtain the clearance of the CWC with the cooperation of the Chief Engineer, Investigation and Planning.

When the project is cleared, preliminary works such as construction of access roads, project camps, detailed pre-construction investigation such as exploring foundation conditions necessary for actual construction and the detailed surveys for preparing detailed working estimates for various components of works for obtaining technical sanctions should be undertaken and completed by Chief Engineer, Investigation and Planning. The Chief Engineer (Projects) should take up the work for actual construction only after the aforesaid preliminary pre construction works are completed and properly handed over to him and detailed technically sanctioned estimates with specification drawings are made available to him.

[Para 3.11 (ii)]

140 At present the staffing patterns of offices of different Chief Engineers appear to be the same.

Similarly, staffing patterns and even organisational strength of various circles and divisions also are almost the same irrespective of the nature and extent of works to be executed by them, which are quite different in different cases. Considering the nature and extent of works of different Engineering offices their staffing patterns have been recommended to suit their functional requirements.

[Para 3.14]

141 In order to expose technical personnel to modern developments/innovations in the field, short term courses/ training, seminars, symposia and workshops as well as study tours are necessary. This ultimately will enhance manpower capability and proficiency as also their application in practice. Such training should be imparted at WALMI which should also run refresher and awareness creation course for Executive Engineers and Superintending Engineers after promotion to these posts.

[Para 3.22]

142 The Irrigation Research Institute should be upgraded to a "Centre of Excellence" in order to make it capable to take up all research problems connected with water resources development, irrigation, drainage, flood control and river training work etc.

[Para 3.23]

The Training Circle presently under CE (Research and Training) should be upgraded to a full fledged" Engineers Training Institute" with the Superintending Engineer as controller of examination.

[Para 3.23]

143 The mechanical wing of the WRD should be restructured to maintain gates and gearings of barrages, dams and other irrigation structures; special repairs and overhauls of inspection vehicles and to maintain a small efficient mobile earth moving unit; installation, operation and maintenance of high head pumps of pump canal system and maintenance of mechanical workshops. The Chief Mecanical Engineer should function under the control of Engineer-in-Chief WMU.

[Para 3.24]

144 The existing Directorate of Purchase and Transport in the department may be renamed as "Directorate of Procurement" and it should also be made responsible for disposal of machines and materials lying under different Chief Engineers which are either not at all required by the department or are surplus at one place but required at another.

[Para 3.25]

145 The department should consider creation of a separate hydel wing to take over the mini-hydel plants for maintenance and operation for exclusive use of the energy generated for operation of deep public tubewells and lift pumps in the command.

[Para 3.26]

146 The recruitment of Junior Engineers should be through a written test and interview by State Public Service Commission. Junior Engineers as and when acquire AMIE should be allowed the pay scale of Assistant Engineers irrespective of whether vacancies in the rank of AE are available or not.

[Para 4.3]

25 per cent vacancies in the cadre of Assistant Engineers every year may be filled up by promotion from the rank of Junior Engineers having Diploma in Engineering and a minimum working experience of eight years. 10 per cent vacancies in the cadre of Assistant Engineer every year may be filled up by promotions from the rank of Junior Engineers having Engineering Degree or its equivalent recognised qualification. This recommendation pre-supposes that there is ban on recruitment of graduate engineers in initial recruitment of Junior Engineers.

[Para 4.6]

147 Rest 65 per cent of annual vacancies in the cadre of Assistant Engineers should be filled up by direct recruitment through the Public Service Commission on the basis of written test and interview. This recruitment should be made every year according to the number of vacancies in order to attract meritorious and talented persons in the State services which is considered necessary for upgrading the technical excellence and proficiency of the engineering cadre besides its alround development.

[Para 4.7]

148 To facilitate entry of young and talented engineers in Bihar Engineering Service Class I, which is considered essential to tone up the efficiency and performance of the department, at least twenty five per cent of the post of the Executive Engineers is recommended to be filled up by direct recruitment in light of rules already framed by the Government.

[Para 4.5]

149 Promotion to selection grade posts including the post of Engineer-in-Chief or its equivalent should not be based on seniority alone but should be on merit cum seniority basis. The instructions contained in letter No 22756 dated 27.11.1976 of the State Department of Personnel & Administrative Reforms in this regard are considered quite relevant and it should be strictly implemented.

For determination of the eligibility for promotion to such posts the performance of the incumbent should be scanned for his entire earlier service period. A clear cut system for evaluating each annual remark should be evolved on the following criteria ratings:

Special commendation by the Government		5 points
Outstanding		4 points
Very Good		3 points
Good	2 points	
Satisfactory		1 point
Censor	minus	2 points
Warning	minus	1 point

The system of writing special CRs should be dispensed with and in case it is unavoidable in exceptional few cases, it should be entitled for maximum of two points only irrespective of the final remarks made therein.

[Para 4.8]

Self assessment with regard to writing of annual confidential reports of engineers should be introduced as prevalent in Maharashtra Government and Central Water Engineering Service with suitable necessary modifications. The confidential reports should be such that the quality of performance, integrity, overall capability etc. are reflected specifically in the remarks without any ambiguity so that the points are assessed accurately and correctly at the time of deciding cases

for promotion to selection posts.

[Para 4.9]

150 Full incentive should be given to all categories of engineers so that they acquire higher qualification. The department should also sponsor its officers to various institutions for higher education and should allow atleast three increments to those engineers who possess M Tech or equivalent degree as given to the officers of judicial service who have done LLM.

Opportunity for attending seminars, symposia and workshops should be fully provided to the officers of the department to upgrade their scientific and technical knowledge.

At least two per cent of annual budget allotment should be clearly earmarked for research and development, training, seminars and workshops etc.

[Para 4.4]

151 The posts of Chief Engineer (CDO), Chief Engineer, (Research) and Chief Engineer (WALMI) should preferably be declared ex-cadre posts. Recruitment to these posts should be made by open competitions through Public Service Commission for a tenure of at least five years.

[Para 4.10]

152 The division of posts in "works" and "non-works" category for transfer and postings should be dispensed with as soon as possible. The following suggestions are being made for consideration in matters of transfer and postings :

Subject to his performance and aptitude, an engineer should be allowed to work in the same wing as long as possible. He may be posted in the field and office assignments alternately in the same wing.

However, to know the aptitude it may be necessary to post a new entrant alternately in all the three wings which may be helpful to ascertain his correct aptitude.

The postings should be decided in the light of past performance, aptitude, qualification of the officer and administrative needs of the department.

Engineers having higher academic qualifications should get preference in posting in Advance Planning, CDO, WALMI and Research Institute.

Deserving and suitable engineers opting for posting in design, research, investigation, monitoring and evaluation wings should be honoured by respecting their wishes as far as possible.

Selection Grade Assistant Engineers should be posted in the Monitoring and Evaluation wing in the Secretariat as far as possible.

[Para 4.12
Para 4.13]

153 The responsibility and powers of the officer directly responsible for execution of works should in no way be diluted and in case of proven neglect of quality of works he should not escape the severest possible punishment.

154 It has been observed that the powers of Executive Engineers have been diluted to such an extent

that they can not issue any cheque against the passed bill without the signature of Accountant of the Division there on. The result is that power and responsibility do not go side by side. This is heavily telling upon the effectiveness of this key post in the engineering set up. This is in no way a positive step to keep watch on expenditure and, therefore, should immediately be done away with.

[Para 4.17]

155 The State TAC is recommended to be reconstituted as below:-

i	Engineer-in-Chief (Flood)	Chairman
ii	Two eminent engineers having acquaintance with behaviours of major Bihar rivers and experiences of flood management works, not below rank of a CE (these members should be nominated every year)	Members
iii	A member of GFCC	Member
iv	A representative of the concerned "Railways" not below the rank of a Chief Engineer	Special Invitee
v	A representative of State PWD (Roads Wing) not below the rank of a Chief Engineer	Special Invitee
vi	Chief Engineer CDO, WRD	Member Secretary

Concerned CE will present the cases relating to their jurisdiction.

[Para 4.18]

156 A Water Resources Board should be constituted under the Chairmanship of Minister, Water Resources Department with the Engineers-in-Chief WMU, Flood, and Projects and Secretary of the WRD (Minor Irrigation) and Agriculture Production Commissioner as ex-officio Members and the Commissioner cum Secretary as ex-officio Member Secretary. The Secretaries of the other concerned user departments may be made permanent invitees. The Board should co-ordinate the activities of various users relating to utilisation of water resources. The Chief Engineer (Hydrometeorology) of WRD may provide all secretarial assistance to the Board and his office may function as the Board's Secretariat.

[Para 4.19]

VOLUME VI (PART IV)

DRAFT IRRIGATION ACT (TOR 7)

157 A Draft Irrigation Act amalgamating various Acts in vogue in the State, concerning irrigation, drainage and flood control, has been prepared under this TOR and is recommended to be adopted in consultation with the State Law Department.

VOLUME IV (PART V)

INTRODUCTION OF SYSTEM MANAGEMENT FOR SELF-FINANCING OF PROJECT (TOR 10)

158 It is necessary for the water managers to be acquainted with the mechanism of the irrigation system for bringing out improvement in its operation. For this they should compare the objectives and adopted norms of the system envisaged at the time of its formulation with those that are under practice after undergoing changes during actual operations in the past. After identifying these basic factors it should be considered how to reorient the objectives and what alterations are possible and desirable. It has to be borne in mind that public expectations of irrigation projects must be kept realistic in order to satisfy them with end products. This could be carried out in the following manner:

a Correct assessment of cultivable command area on village maps (updated as per current land use) showing area suitable for cultivation in different crop seasons.

b Computation of dependable water yield based on updated historical data.

c A physical inventory of the canal system and structures etc to ascertain their present capacities and condition.

d Annual review of cropping pattern taking into account the pattern prescribed by the Agriculture Department and adjustment of crop calender to synchronise opening and closure of source with crop needs.

e Correct assessment of evapotranspirational needs of crop based on updated long term climatological data.

f Correct assessment of effective rainfall based on long term data incorporating crop stages and cultural practices etc.

g Determination of depth, duration and time of water requirement for each crop.

h Working out weekly demand at canal head taking into account the realistic field application and conveyance losses.

i Preparation of working table to match the demand with availability and working out delivery schedule including fixing of rotational supply to different zones of the command area and preparation of Warabandi schedule.

159 Regular studies should be carried out in the canal system and in the outlet command to ascertain the possible water losses and to decide remedial measures thereon.

160 In order to fully utilise the potential created after investments made on headworks and major canal system, the system must be completed in all respects upto the farm level and maintained in good shape by timely repairs.

161 "Walk through survey" before beginning of each crop season is a must to have full acquaintance with the condition of the system. It is necssary to provide for the farmers' requirement of water which sometimes are in short supply and sometimes in excess for the reasons beyond their control. The water managers have not only to ensure supplies from the head works in the canal system but to ensure that it is adequately available to all the farmers of the command area at proper time according to agreed schedule and existing crop requirement. Occurrence of rainfall should always be in mind for which real time data should be collected and transmitted to the

control room for saving precious water specially in a storage based system.

162 Allotment of O/M fund on commanded area basis should be given a go by and fund allocation should be in accordance with actual requirement as per realistic estimate workedout on the basis of surveys made after irrigation season is over.

163 For successful operation and maintenance of a project to derive anticipated benefit, an efficient tele-communication network is a must with control rooms at suitable locations such as in the offices of the Executive Engineer, Superintending Engineer and Chief Engineer.

164 Exclusive monitoring cell should be established in each project with a computer unit. This cell should prepare a broad data base for planning purposes, monitor demand and supply positions and also monitor rainfall, gauge and discharges at various locations in the system to ensure adequate and timely supply of water according to agreed schedule to meet the crop requirement.

165 The departmental organisation should have functional reorientation to meet the growing need of specialised irrigation management aiming towards optimising productivity per unit of water as well as each unit of land.

166 A very close and bilateral communication between agricultural extension officers and water managers is necessary to function as an inbuilt system for micro-level planning of crop production and water requirement (both in terms of depth and duration) for maximum yield per unit area with the water available.

167 Farmers' participation in the managemerft through better involvement i.e. in operation, maintenance, assessment and collection of water charges, is essential not only for the betterment of farmer's economy rather it is must for survival of the system as it would meet the aim of both the farmers and the managers.

168 Land shaping and consolidation of holdings should be carried out in all projects and management of land and soil should form part of the irrigation system management.

169 All factors affecting the yield of crop such as quality of land, adequacy of fertilizer application and quality seeds etc must be taken care of so that the cultivators may derive full benefit of irrigated agriculture in right earnest and they are assured of better farm income as a result of increased yield.

170 Development of rail, road and inland water-way communication, marketing infrastructure, agrobased industries have to be promoted to boost up farm and labour income through irrigated agriculture for which scope widens in project command.

171 At many places efficiency of water distribution is lowered by tempering of the system gates by farmers, breaking of the gates of outlets or taking away the shutters etc ,which indicate the need for better security of the system particularly the structures. The security of the structures by fencing and locking arrangements, guarding gates etc may have to be provided for proper management of the system.

172 For improving technical capability and knowledge necessary to improve system performance and the leadership skill to work effectively in co-operation with farmers, officers of the departments as well as members of WUA should be imparted training on a regular basis in order to be update with the improved operation techniques and procedures. Training of staff for closing and opening of the canals strictly as per schedules drawn, controlling the flow in the canals, taking measurements and improved maintenance of the system would also be necessary, so as to reduce the operation loss to increase the efficiency of the system.

VOLUME VI (PART VI)

STRUCTURE OF DIRECT AND INDIRECT REVENUES (TOR 11)

173 The present day investment costs of major and medium irrigation projects are so high that it would be rather impossible to recover the entire fixed cost of the project from the beneficiaries directly in terms of water rates. This view is also in line with the views contained in the National Water Policy and the State Irrigation Policy. As such, there appears no option other than to continue to subsidise the irrigation water supply in due consideration of the farmers' capacity to pay.

174 It is, however, acknowledged that the existing water rates in the State are far less to cover even the bare operation and maintenance charges. It is, therefore, obvious that the existing water rates prescribed for various crops need immediate upward revision. These rates were last revised in the year 1983 more than a decade back since when there has been steep rise in the value of irrigated crops. In this view of the matter also an upward revision of water rates immediately is called for. Accordingly, considering all the pros and cons of the matter involved, this Commission suggests upward revision of the existing water rates in the following manner :

a Recovery of entire annual cost of O and M only in the first phase to be enforced immediately.

b Recovery of entire annual cost of O and M plus one percent interest charges on capital outlay of the projects in second phase to be enforced after 5 years of enforcement of (a) above.

c Recovery of entire annual cost of O and M and one percent interest charges on capital outlay of the projects and one percent depreciation charges in the next stage after five year of enforcement of (b) above.

175 This Commission also holds the view that while fixing water rates on the aforesaid basis, criteria relating to capacity of the farmers to pay should be accorded due weightage and rate fixation may be limited to capacity level. Till the capacity of farmers to pay the water charges is not such as to recover even the bare O and M cost, the water rate shall have to be subsidised to that extent.

176 It would be justifiable to assess the farmer's capacity to pay in terms of the additional net benefit that accrue to them due to introduction of irrigation. Scientific evaluation of the benefits from rainfed and irrigated agriculture from crop harvest tests on multilocational samples would be necessary to arrive at such additional net benefit. These details are not available and in absence of which it is not only difficult but almost impossible to arrive at a rational and accurate value of net additional benefit due to introduction of irrigation facilities.

177 Till it becomes possible to scientifically work out the accurate net additional benefit, the farmers capacity to pay, to start with, may be taken as suitable percentage of gross income to the farmer from irrigated crop which may be taken as 5.0 percent to 12 percent of the gross income from produce of specified crops (the higher limit may be applied to cash crops and the lower to food crops).

178 The First Bihar State Irrigation Commission (1971) had made the following recommendation for assessment of the indirect revenue derivable by the State as a result of introduction of irrigation facilities:

"An assessment of the indirect revenue derivable by the State (irrespective of whether recoveries are actually made from the cultivators or not), as the result of introduction of irrigation facilities should be made by conducting socio-economic survey of irrigated tracts and unirrigated tracts in the region, as soon as irrigation is well established in the area. A suitable percentage (say 50 percent of such indirect revenue) should be credited pro-forma, to the financial accounts of the

irrigation project when assessing its financial position."

This Commission fully endorses the above recommendations of the earlier State Irrigation Commission. It has, however, to be ensured that sampled unirrigated and irrigated tracts should be in the nearest vicinity.

179 Before enforcing the recommendations contained in sub paragraphs 174 (b) and 174 (c) above, it would be necessary to improve the system through a package of measures to achieve a higher level of efficiency in water use. For which, this Commission is of the opinion that the following measures at technical/management level would be necessary:

a Making the system capable of supplying water adequately and timely to meet the crop water requirement without fail.

b Ensuring overall irrigation efficiency i.e. to reduce the conveyance and application losses in the systems as well as wasteful uses to the barest minimum.

c Adoption of sophisticated techniques and mechanisation to harmonise the conjunctive use of surface and ground water in a flexible manner depending upon the quantum of supply and demand.

180 This Commission recommends levying of an irrigation cess at the rate of Rs 20/- per ha per annum on all culturable irrigable land either already covered by the existing projects or proposed to be covered by the on-going and future major, medium as well as minor irrigation (both surface and ground water) projects in all river basins of the State.

181 The Commission recommends that a general tariff of Rs 0.66 per kilo-litre (Rs 3/- per thousand gallon) should be realised for all cases of industrial water supply from the rivers of the State with effect from 01.11. 1993. The cost of any intake structure on the river or any conveyance system built by the State Government necessary for effecting such supply shall be recovered along with its O & M charges in addition to the above tariff. This tariff should be linked with Wholesale Price Index and revised every year accordingly. There should also be a provision for levying of a minimum guarantee for such tariff based on at least fifty per cent of the contract demand irrespective of the fact whether supply is availed of or not.

182 It is recommended that the BSEB which earning revenue from hydel power generation on the infrastructure created by the WRD should pay at least 5 (five) per cent of its tariff, earned on such irrigation structures, to WRD, in order to share at least nominal cost of benefits derived bt it from the infrastructure created by the WRD.

183 It is recommended that issue of reviving navigation facilities in Sone and other canals (wherever feasible) should be revived by providing quick and efficient transit system at various locks and suitable docking, loading and unloading facilities at important places enroute. Suitable navigation, toll should be worked out and, levied in order that the operation and maintenance cost of such facility together with interest charges on capital investment are recovered from the transporters. The charges may be on the basis of boat size and distance.

184 The department has been able to lease out four major reservoirs for ten years and five medium reservoirs for five years which are expected to fetch an additional revenue of Rs 56 Lakh. However, considering the fact that the department has already constructed 27 major and 163 medium schemes, the achievement in this front seems to be far less than desired.

It is recommended that pisciculture should be developed in all the reservoirs/barrage ponds of the WRD so as to earn maximum possible revenue on account of this.

Depressions and artificial ditches formed along the canals may be utilised for growing singharas, makhana, paddy, jute, sugarcane and grasses. The water-logged areas, artificially formed after construction of project structures, may be annually cultured with desired plant species or by aqua-culture.

185 Reservoirs, ponds and even canals provide good scope for development of motels and recreation centre to encourage tourism which can be good source of revenue for the project. Recreation, therefore, should also be made a part of the major and medium irrigation and multipurpose projects by adding new constructions on selected spots.

186 According to the latest resolution of State Department of Forest and Environment issued on 16th to 19th February 1994, the land covered by the canals and embankment had been declared protected forest and such lands are to be managed by the Forest Department and Bihar State Forest Development Corporation. However, the ownership of the land rest with the WRD and any bonafied works of repair etc can be done by the officers authorised by the WRD without the permission of the Forest Department. This decision is likely to lead to conflict between the WRD and Forest Department with respect to the bonafide works of repair.

This Commission, therefore, suggests that proper machinary should be involved by the State Government for effective cordination between the two departments so that the works of repair of canal banks and embankments do not get hampered at any critical juncture. Besides, the credit for sale of trees on flood embankment and canal bank should be passed on to the WRD as the plantation have been done at the cost of the project. Fifty per cent of the sell proceeds of such trees which have been planted at the cost of the forest or any other department, should be credited to the WRD who are the owners of the land.

It is recommended that the rate of lease of chat land should be revised upwards as the present rate of Rs 106/- per acre per annum including irrigation rate appears to be too low. Inventory of such land in each project command should be prepared on priority basis and the charges for lease of such lands should be fixed in a manner to be compatible with those charged by the private owners in the viscinity. No separate water rate should, however, be charged on lease of such Government land.

ACKNOWLEDGEMENTS

We would like to put on record our sincere thanks to MPs, MLAs, MLCs, Other distinguished members of the public, Retired and Serving Engineers, BDOs, Mukhias and Sarpanchs (Appendix VI) who very sincerely sent replies to the questionnaire of the Commission. Short of whose response it would not have been possible for the Commission to introduce realism, objectivity and purposefulness in its reports in their present form. Our special thanks are due to the experts and specialists of various disciplines for their valuable opinions and advice during group discussions held in the office of the Commission or during the site visits by its panels of experts.

We would like to express our grateful thanks to various departments and organisations of the State and Central Governments which sent replies to our questionnaire and furnished data and information to the Commission for the preparation of its reports. Special mention is made of the large amount of co-operation and help received from the Central Water Commission, Ganga Flood Control Commission, State Directorate of Statistics and Evaluation, Agriculture Department, State Ground Water Directorate, Public Health Engineering Department, Hydrology Cell of the Water Resources Department and the State Planning Board.

We are also thankful to the Sone and Gandak CADAs for sending us very exhaustive reports and other information on command area development and to Bihar State Remote Sensing Application Centre for providing land-use maps based on satellite imageries. The National Bureau of Soil Survey

and Land Use Planning at Calcutta and Scientists of Rajendra Agriculture University, Pusa and Birsa Agriculture University, Ranchi, deserve sincere thanks for furnishing valuable information on the soil and cropping patterns of Bihar and for their co-operation in evolving the prospective cropping pattern in different river basins of the State.

We are thankful to the Block Development Officer of the CD blocks listed in Appendix VII, who took immense pains to arrange meetings of the Mukhias and others so as to identify the schemes for water resources development in their blocks which they forwarded to the Commission. We are also thankful to the DMs/DCs/Officers of different districts who made available their valuable views and suggestions in response to the requests made by the Commission and to the Officers of the Water Resources Department who arranged field visits and extended to us their hospitality and facilities to acquaint us with ground realities relating to provision of irrigation services in their areas.

It is our pleasant duty to place on record our deep appreciation of the valuable services rendered by the Officers and Staff of the Water Resources Department attached with the Commission. Their untiring labour and perseverance enabled the Commission to bring about volumes of reports on different terms of reference, findings and recommendations. In particular, the earnest and hard work of Sri Bimal Prasad Choudhary, Sri Shyam Sundar Prasad Singh, Sri Indranan Singh, all Executive Engineers, in arranging meetings, organising the visits, collecting data and preparing agenda notes are gratefully acknowledged. We are highly indebted to the earnest and painstaking hard work rendered by most of Assistant Engineers attached to the Commision such as Sri Ashok Kumar Prasad, Sri Bipin Bihari Mishra, working on Computer, Sri Ajit Kumar Samaiyar, Sri Anil Kumar Sinha, Sri Bipin Kumar, Sri Harish Kumar, Sri Janaki Prasad Ghosh, Sri Jatadhari Singh, Sri Kedar Prasad Singh, Sri Madan Mohan Gupta, Sri Manoranjan Swaroop, Sri Ramesh Kumar, Sri Suresh Kumar, Sri Binod Kumar, Sri Vibhuti Nath Jha, Sri Veda Kant Pathak and Sri Shambhu Prasad associated with preparation of reports on various terms of references. In addition, Junior Engineers such as Sri Suman Prasad Singh, Sri Gulab Prasad Singh, Sri Ram Nath Singh, Sri Rakesh Kumar, Sri Sudhansu Kumar, Sri Kumar Arvind, Sri Bachchu Sharma, Sri Krishna Nandan Singh, Sri Lakshman Yadav, Sri Narendra Singh, Sri Prabhat Kumar Pyasa, Sri Rajender Shahu made appreciable contribution in data analysis and in many other ways like photocopying, compilation, etc. We would be failing in our duty if we donot acknowledge the services rendered by Sri Jitendra Trivedi (State Officer), Sri Ram Lakhan Mistri, Sri Santosh Kumar, Sri Narayan Singh, Sri Binod Kumar Thakur (all typist) working as Computer Operator, draftman and tracer headed by Sri Brinder Kumar Sinha, drivers Sri Surendra Prasad, Sri Ganesh Prasad and Sri Ashok Kumar and peons Sri Krishna Dev Rai and Sri Jagannath, all of whom stood firmly even during late hours of work in the Commission.

17.8.94

(Jagdanand)
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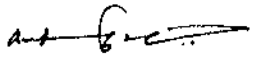
17.8.94 (Dr K N Prasad) Member (Economist)	(J Ram) Member (Agriculture Expert)	(C M Jha) Member (Agriculture Production Commissioner, Bihar)



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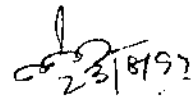

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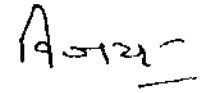

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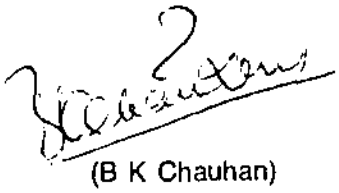

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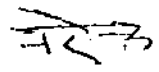

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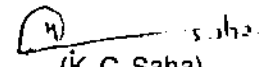

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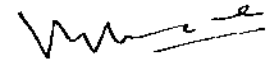

(V B Bhagat)
Member Secretary
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APPENDICES

Appendix I

GUIDELINES FOR THE IMPLEMENTATION OF THE RECOMMENDATIONS OF THE FIRST BIHAR STATE IRRIGATION COMMISSION

DEVELOPMENT OF WATER RESOURCES

1 IRRIGATION PROJECTS SHOULD BE PLANNED FOR 75 PER CENT DEPENDABLE FLOW IN THE RIVERS OF NORTH BIHAR AND PLAINS OF SDUTH BIHAR AND FOR 50 PER CENT DEPENDABLE FLOW FOR THE REST OF THE STATE.

(Paras 8.1.1 and 8.1.3)

Since there is difference in recommendation and actual practice, as per CWC's guidelines, this recommendation should further be examined and suitable recommendations made by the 2nd Bihar State Irrigation Commission.

2 FUTURE UTILISATION OF WATER FOR AGRICULTURAL USE HAS TO BE WORKED OUT ON THE AVAILABILITY OF WATER IN THE RIVERS DURING THE DIFFERENT CROP SEASONS AND IRRIGATION PERIODS.

(Para 10.1.2)

3 OPTIMUM INTENSITIES OF IRRIGATION FROM SURFACE WATER FOR THE DIFFERENT CROP SEASONS FOR DIFFERENT ZONES OF THE STATE SHOULD BE FIXED. HIGHER INTENSITY OF IRRIGATION, IF REQUIRED FOR INCREASED AGRICULTURAL PRODUCTION SHOULD BE ACHIEVED BY SUPPLEMENTING SURFACE WATER WITH GROUND WATER WHERE AVAILABLE. IN ALL IRRIGATED AREAS, WHERE ADEQUATE SUB-SURFACE WATER IS AVAILABLE, CONJUNCTIVE USE OF SURFACE AND SUB-SURFACE WATER SHOULD BE MADE TO HELP KEEP IN CHECK THE RISE OF GROUND WATER TABLE.

(Paras 10.1.3, 11.1.2 and 12.4)

4 WHERE ADEQUATE SUB-SURFACE WATER IS AVAILABLE AT REASONABLE DEPTHS, THE AVAILABLE SURFACE WATER SHOULD BE UTILISED IN AN EXTENSIVE AREA. FOR PROMOTION OF INTENSIVE CULTIVATION, SUB-SURFACE WATER SHOULD SUPPLEMENT THE SURFACE WATER.

(Para 12.1)

5 IN THE PLAINS, WHERE IRRIGATION FACILITIES FROM SURFACE WATER ARE NOT ECONOMICALLY AVAILABLE, SUB-SURFACE WATER SHOULD BE UTILISED, IF AVAILABLE.

(Para 11.2.4)

These recommendations are acceptable provided provision is made for other uses in the basins. Planning for irrigation should be done keeping in view the water available for agricultural use. The 2nd Bihar State Irrigation Commission may go into details of the availability of water for agricultural and other uses basinwise.

Note: Para number within parenthesis indicates para number of the report of First Bihar State Irrigation Commission, 1971.

6 EXCEPT IN THE CASE OF RIVERS WITH ADEQUATE PERENNIAL FLOW, ASSURED IRRIGATION IS POSSIBLE ONLY WITH ADEQUATE STORAGE, STORAGE RESERVOIRS IN SOUTH BIHAR SHOULD BE LOCATED ON THE MAJOR STREAMS AND THEIR IMPORTANT TRIBUTARIES. STORED WATER SHOULD BE UTILISED FOR IRRIGATION OF AREAS LYING IN THE PLAINS AND IN THE PLATEAU OR SUB-PLATEAU AREAS WHEREVER POSSIBLE.

(Para 11.2.1)

7 SMALL STORAGE RESERVOIR SHOULD BE CONSTRUCTED IN CHOTANAGPUR IN THE TRIBUTARIES OF THE MAIN RIVERS TO IRRIGATE SMALL COMMANDS AT HIGHER ELEVATION.

(Para 11.3.1)

8 EXISTING DIVERSION SCHEMES SHOULD BE STABILISED BY PROVIDING UPSTREAM STORAGE, WHEREVER POSSIBLE.

(Para 11.2.3)

Since the topography of South Bihar comprises the plateau area, the plains and the transitional zones between the hills and the plains, the rivers in this region area flashy and have very little discharge in the dry season. The First Bihar State Irrigation Commission recommended adequate storage facility for assured irrigation in this region. The sites for storage dams and reservoirs have been located on the major rivers and their important tributaries in the hilly areas. Water stored in these reservoirs should be used for irrigation in the plains and in the plateau areas wherever possible. A number of storage dams have been constructed and many are under execution and planning stages.

However, the cultivable areas in this region, which have not been brought under assured irrigation facilities so far, should be assessed and investigation, planning and construction of such storage dams, as may be necessary for providing assured irrigation to the remaining cultivable area, should be undertaken.

9 AHARS AND 'TANKS' SHOULD BE DEVELOPED AS SMALL DETENTION RESERVOIRS TO STORE MONSOON WATER. DIVERSION SCHEMES WITHOUT STORAGE FACILITIES SHOULD BE CONNECTED THROUGH CANALS WITH THE 'AHARS' AND 'TANKS' FOR PROVIDING SHORT TERM STORAGE.

(Para 11.2.2)

10 IN THE ABSENCE OF SUITABLE STORAGE RESERVOIR SITES, WATER SHOULD BE STORED IN NEWLY CONSTRUCTED 'AHARS'. EXISTING 'AHARS' SHOULD BE IMPROVED.

(Para 12.1)

As recommended by the First Irrigation Commission, 'Ahars' and 'Tanks' should be developed as small detention reservoirs for storage of monsoon water. Diversion schemes without storage facilities should be connected through canals to the newly constructed 'Ahars' and 'Tanks' for providing short-term storage. Existing 'Ahars' should be improved.

There are only a few old irrigation schemes mainly in South Bihar in which old private 'Ahars' and 'Tanks' are linked with the diversion canals. There are a few 'Ahars' in lower Morhar also which store excess water during monsoons.

Although 2 to 3 thousand pynes, tanks and weirs were reported to have been constructed by the Minor Irrigation Department, these do not form part of unified irrigation schemes within an overall development plan of irrigation facilities in the basin as a whole. It is high time that these old Ahars, Tanks, Pynes, etc. are taken over by the Government, improved and deepened and these together with the new ones are made integral part of the irrigation system.

11 WITH NEW STORAGE RESERVOIRS, THE EXISTING WEIRS AND CANAL SYSTEMS SHOULD BE REMODELLED TO SERVE LARGER COMMAND.

(Para 12.1)

The summary of this recommendation is as follows:-

"With new storage reservoirs, the existing weirs may function as pick-up weirs. The existing weirs and canal system should be remodelled to serve larger command."

It is imperative that the available water resources should be exploited in the best possible manner for the development of agriculture industry and power generation. The first Irrigation Commission has, therefore, suggested that the State should be divided into a number of river basins and comprehensive Master Plan should be prepared for each basin. While preparing the comprehensive Master Plan for each river basin, the existing weirs and canal systems should be incorporated within it as far as possible on the lines suggested by the Commission for the optimum development of inadequate water resources in the State.

12 WITHIN PHYSICAL LIMITATIONS, POSSIBILITIES OF TRANSBASIN TRANSFER OF WATER SHOULD BE INVESTIGATED.

(Para 11.3.7)

The 2nd Bihar State Irrigation Commission may examine its possibility and make suitable recommendations.

13 WHERE FEASIBLE, HIGH LIFT PUMPS SHOULD BE INSTALLED AT SUITABLE SITES ALONG THE GANGA, TO IRRIGATE AREAS THAT CAN BE COMMANDED.

(Para 11.2.6)

Execution of many lift pump canal schemes to lift water from the river Ganga have already been undertaken in line with this recommendation. Notable examples are those of Chousa, Surajgarha, Dakranala, Batesharsthan and Sakarigali Pump Canal Schemes. Several such pump canal schemes have been reported to be coming up on the rivers like Karmnasa, Sone and others.

However, survey and investigation work should be undertaken to explore the technical feasibility and economic viability for such new schemes along the Ganga to bring about unirrigated areas under their command. Moreover, it would be worthwhile to take into account the performance of the old schemes while planning and designing the new ones.

14 TO EXPEDITE UTILISATION OF IRRIGATION POTENTIAL, DRAINAGE AND LAND DEVELOPMENT WORKS SHOULD BE COORDINATED AND TAKEN UP WITH IRRIGATION WORKS.

(Paras 20.4. and 11.1.5)

This recommendation is an important one and should be implemented with due priority for the

optimum utilisation of the created irrigation potential.

The trunk drainage schemes have been taken up by the Water Resources Department and lot of works appear to have been done in this regard. But farm drains which would have come up with the field irrigation channels are conspicuous by their absence. Land development works have been assigned to different Command Area Development Agencies, but precious little works appear to have been done in this regard. Activities of these agencies have remained confined mainly to construction of field channels without scientific consolidation of land holdings. Land development programmes should include consolidation of holdings between field channels and field drains.

15 IN APPORTIONING WATER, DUE CONSIDERATION SHOULD BE GIVEN TO SUB-SURFACE WATER, IF THE SAME IS AVAILABLE AT REASONABLE DEPTHS WITHIN THE COMMAND. PREFERENCE SHOULD BE GIVEN TO APPORTION SURFACE WATER TO THE AREAS WHERE OTHER SOURCES OF WATER ARE NOT ECONOMICALLY AVAILABLE.

(Para 12.1)

The 2nd irrigation Commission may further examine this item and may come out with specific recommendations basinwise.

16 WHERE GRAVITY CANALS ARE NOT FEASIBLE WITHIN PRACTICABLE LIMITS, A PART OF THE RIVER FLOW MAY BE LIFTED. AREAS LYING BETWEEN STORAGE RESERVOIRS AND PICK-UP WEIRS, AND THOSE ABOVE STORAGE LAKES OR NEAR THE HEADWORKS OF CANALS MAY BE IRRIGATED BY LIFT IRRIGATION.

(Para 12.1)

As recommended by the First Irrigation Commission in Chotanagpur and in some areas of South Bihar where gravity canals are not feasible, within practicable limits, a part of the river flow may be lifted. Areas lying between the storage reservoirs and pick up weirs as also those lying above storage lakes should be irrigated by lift irrigation. Possibility should be explored and survey and investigation works undertaken in this regard keeping in mind the present and future power position of the State.

IN NORTH BIHAR

17 a SHORTAGE OF WATER IN THE DIFFERENT RIVERS DURING THE RABI AND HOT WEATHER SEASONS COULD BE PARTLY MET BY INTER-BASIN TRANSFER OF SURPLUS WATER WHEREVER AVAILABLE.

(Paras 10.1.3 and 11.1.1)

During Rabi and Hot Weather period, there have been storages of surface water in almost all basins. In North Bihar this situation is unlikely to change unless storage reservoirs come up on the rivers like the Kosi, Gandak, Bagmati and Kamla.

In South Bihar, however, possibilities of transbasin diversion of water ought to be investigated, within physical limitations, to meet the storage of water in the basin.

b CROPPING PATTERN AND INTENSITY OF IRRIGATION MAY BE ADJUSTED IN FUTURE IF AND WHEN STORAGE ARRANGEMENTS COULD BE ARRANGED.

(Para 11.1.3)

The cropping pattern and intensity of irrigation should be readjusted with provision of storage arrangements.

c BULK OF THE RIVER FLOW DURING THE MONSOON AFTER KHARIF IRRIGATION AND THE BALANCE FLOW AFTER RABI AND HOT WEATHER IRRIGATION SHOULD BE RELEASED DOWN THE RIVER FOR NAVIGATION AND LOWER RIPARIAN REQUIREMENTS.

(Para 11.1.6)

Bulk of the river flow during the monsoon cannot be utilised for irrigation and, therefore, should be allowed to go down the river, In the dry season though most of the water required for irrigation, the small balance, if any, left after allowing for the proposed maximum intensities for surface irrigation should be released down the river for navigation purposes and lower riparian requirements.

Besides, navigation and other riparian rights can be facilitated through the reservoirs themselves by means of canals. Therefore, projects should be planned and designed on these lines.

d LANDS DEPRIVED OF GETTING RICH SILT FROM FLOODS AFTER CONSTRUCTION OF FLOOD EMBANKMENTS SHOULD BE BROUGHT UNDER IRRIGATION AS EARLY AS POSSIBLE.

(Para 11.1.4)

Most of the areas in North Bihar and some areas in South Bihar, where irrigation schemes have not been proposed so far, are subject to flooding. Flood embankments have been proposed and constructed to protect most of these areas. Though devastations are caused by floods, they have beneficial effects also in as much as rich silt is deposited over the lands. As these lands would be deprived from getting rich silt after the construction of flood embankments, the same should be brought under Irrigation as early as possible.

Lands deprived of getting rich silt carried by the floods after construction of embankments are being brought under irrigation in the case of Kosi and Gandak rivers which is in line with this recommendation. Similar actions should be taken in all river systems where lands have been deprived of rich fertilizing silt due to the construction of embankments. Loss of fertility of soil outside the Bagmati Embankments is quite noticeable which is causing discontentment among the farmers.

e CHAURS AND MANS SHOULD BE DRAINED TO THE EXTENT FEASIBLE. AREAS WHICH CANNOT BE DRAINED BY GRAVITY COULD BE DEVELOPED FOR FISHERIES. WATER COULD BE PUMPED FOR IRRIGATION OF SURROUNDING AREAS TO BRING ADDITIONAL AREAS UNDER RABI AND HOT WEATHER CULTIVATION.

(Para 11.1.7)

A detailed study should be carried out by the 2nd Irrigation Commission to find out the effect of drainage schemes on floods and to recommend suitable actions.

f REQUIREMENT OF WATER FOR INDUSTRIAL AND/OR DOMESTIC PURPOSES COULD BE MET WHOLLY OR PARTLY WITH GROUND WATER AND/OR SURFACE WATER.

(Para 11.1.8)

This recommendation which has been summarised by the First Irrigation Commission as follows should be implemented and future projects planned accordingly:- "As the whole of North Bihar has

good sources of ground water, the requirement of water for industrial and/or domestic purposes may be met wholly or partly with ground water and/or surface water".

18 IN CHOTANAGPUR

a LARGE NUMBER OF TANKS SHOULD BE CONSTRUCTED AND THE EXISTING TANKS SHOULD BE DEEPENED TO HOLD MORE WATER.

(Para 11.3.2)

Since most of the areas in Chotanagpur are hilly, the First Irrigation Commission had recommended the construction of large number of tanks and deepening of existing ones wherever possible to hold more water. This recommendation should be implemented and projects prepared accordingly.

b SERIES OF BUNDS WITH ADEQUATE SPILLWAYS SHOULD BE CONSTRUCTED IN THE VALLEYS FOR IRRIGATION OF SUITABLE AREAS ALONGSIDE.

(Para 11.3.3)

Minor Irrigation Department has already constructed 2 to 3 thousand pynes, tanks and weirs etc. However, possibility of making the existing schemes more effective and feasibility for more such schemes should be explored and investigated.

c LARGE DIAMETER (25 FT TO 30 FT) SURFACE WELLS SHOULD BE CONSTRUCTED IN THE VALLEYS TO IRRIGATED SMALL CULTURABLE PATCHES OF LAND AND SUPPLY WATER FOR DOMESTIC USE.

(Paras 13.3.5 and 10.1.8)

The size of the wells needs further examination by the 2nd Irrigation Commission.

Ist Irrigation Commission recommended large diameter (25 ft to 30 ft) surface wells but Minor Irrigation Department has reported the use of 10 ft diameter wells. This may be studied and suitable recommendations made.

d WATER FROM THE SANDY RIVER BEDS COULD BE TAPPED TO IRRIGATE SMALL AREAS AND MEET LOCAL DOMESTIC REQUIREMENTS.

(Para 11.3.5)

Recognising the need to irrigate small areas and meet local domestic requirement, the Commission had recommended that water should be tapped from the sandy river beds in Chotanagpur.

This recommendation should be implemented.

e COMMERCIAL PLANTATIONS AND ORCHARDS SHOULD BE DEVELOPED IN THE UPLANDS TO RETAIN WATER AND DEVELOP SPRINGS IN THE VALLEYS BELOW.

(Para 11.3.8 and 10.1.8)

Planned efforts should be put in to develop commercial plantations and orchards in the uplands to retain water and develop springs in the valley below as a means of treatment of a basin as a whole. Cultivation of crops in these areas should be replaced by growing suitable type of fruit bearing trees and plantation of commercial trees.

f TO RETAIN SOLD AND MOISTURE FOR SUFFICIENT LENGTH OF TIME FOR GROWING CROPS, DRY FARMING METHODS INCLUDING CONTOUR RIDGES SHOULD BE ADOPTED, WHERE IRRIGATION IS NOT FEASIBLE.

(Para 11.3.9)

The summary of this recommendation is as follows:-

"Where irrigation is not feasible, dry farming methods including contour ridges should be adopted for retaining soil and moisture for sufficient length of time to enable crops to be grown.

Dry farming methods with contour ridges appear to have been practiced by the Agricultural Department. But the contour ridges have been adopted taking the property line into main consideration. This can be done more effectively if consolidation of land is done respecting the contours.

This recommendation should be implemented.

19 PRIORITY SHOULD BE GIVEN FOR USE OF WATER FOR AGRICULTURAL PURPOSES IN THE PLAINS OF NORTH AND SOUTH BIHAR AND FOR INDUSTRIAL PURPOSES IN CHOTANAGPUR.

(Para 12.3)

This recommendation may be reviewed basinwise by the 2nd Irrigation Commission in the light of National Water Policy.

20 INSTEAD OF CAPITAL COST,IRRIGABLE AREA SHOULD BE THE BASIS FOR CLASSIFICATION OF IRRIGATION WORKS AS MAJOR, MEDIUM OR MINOR. IRRIGATION PROJECT TO IRRIGATE MORE THAN ONE LAKH ACRES SHOULD BE CLASSIFIED AS MAJOR, THOSE BETWEEN FIVE THOUSAND AND ONE LAKH ACRES AS MEDIUM AND THOSE BELOW FIVE THOUSAND ACRES AS MINOR. MAJOR, MEDIUM AND MINOR IRRIGATION WORKS ARE ALL NECESSARY FOR THE DEVELOPMENT OF IRRIGATION IN THE STATE AND THEY SHOULD BE COMPLEMENTARY TO EACH OTHER RATHER THAN IN SUBSTITUTION.

(Para 12.5)

The classification of projects of the basis of the irrigable area is alright.However, the criterion prescribed by the Planning Commission should continue to be followed.

21 STATE TUBEWELL PROJECTS SHOULD COME UNDER THE CATEGORY OF MEDIUM PROJECTS AND SHOULD BE TAKEN UP IN COORDINATED MANNER ALONG WITH THE PLANS OF CONSTRUCTION OF MAJOR AND MEDIUM CANAL IRRIGATION PROJECTS.

(Para 12.5)

This recommendation needs to be reviewed by the 2nd Irrigation Commission.

22 STATE TUBEWELLS OF 6"/8" DIAMETER SHOULD NOT NORMALLY BE SPACED LESS THAN 3/4 MILE APART. IN EXCEPTIONAL CASES, SPACING OF TUBEWELLS IN HIGH YIELDS ZONES MAY BE REDUCED TO 1/2 MILE APART BUT IN NO CASE IT SHOULD BE LESS THAN THIS DISTANCE. PRIVATE TUBEWELLS OF 4" DIAMETER SHOULD NOT BE SPACED LESS THAN 1 FURLONG IN ANY CASE.

(Para 8.2.3)

23 DUE TO SHORTAGE OF BRASS AND OTHER ALLOYS, STRAINER WELLS SHOULD BE GRADUALLY DISCONTINUED. GRAVEL SHROUDED WELLS WHICH ARE COMPARATIVELY CHEAPER AND GIVE HIGHER YIELDS SHOULD BE PREFERRED. GRAVEL SHROUDING SHOULD, HOWEVER, BE DONE CAREFULLY TO AVOID FAILURES DUE TO USE OF IMPROPER MATERIAL OR INCORRECT GRADING OF GRAVEL.

(Para 8.2.3)

24 THE FIRST AQUIFER LYING WITHIN 70 TO 80 FT. FROM THE GROUND SURFACE SHOULD BE LEFT OUT FDR DEVELOPMENT OF PRIVATE TUBEWELLS AND BORINGS FROM OPEN WELLS.

(Para 8.2.4)

These recommendations are being followed and no further comments are required by the 2nd Irrigation Commission.

25 NECESSARY LEGISLATIVE MEASURES SHOULD BE ENDORSED FOR CONTROLLING EXPLOITATION OF UNDERGROUND WATER RESOURCES.

(Para 12.4)

The 2nd Irrigation Commission may examine the status of ground water utilisation in the State. The 2nd Bihar State Irrigation Commission proposes to collect literature about enactment of legislations of other State like Gujrat and Maharashtra. After studying these legislations, the present Commission will make suitable recommendations in this regard.

CONSERVATION OF WATER

26 TO ASSURE PROPER DISTRIBUTION OF WATER AMONGST BENEFICIARIES 'AHARS' AND SMALL TANKS WHICH WERE OWNED AND MAINTAINED BY ZAMINDARS SHOULD BE REPAIRED AND MAINTAINED BY THE GOVERNMENT. IF NECESSARY, THE BIGGER 'AHARS' SHOULD BE TAKEN OVER AND PLACED UNDER THE CHARGE OF IRRIGATION OR MINOR IRRIGATION DEPARTMENT WITH SUITABLE ARRANGEMENTS FOR THEIR IMPROVEMENT, REPAIR, MAINTENANCE AND OPERATION. SUITABLE WATER RATES MAY BE CHARGED FOR AREAS BENEFITED BY IRRIGATION BY ENACTING LEGISLATION IF NECESSARY.

(Para 15.1 and 15.2)

With the abolition of Zamindari system, 'Ahars' and small tanks have ceased to receive due attention and many of them are new in a state of disrepair. 'Ahars' provide a useful source of irrigation in undulating tracts where major or medium schemes are not feasible or contemplated in the near future. The existing 'Ahars' and small tanks should, therefore, be improved, properly maintained and operated to provide the maximum possible benefits to the cultivators concerned. In order to achieve this objective, such Ahars and small tanks should be taken over by the State Government, maintained and made integral part of the unified irrigation system.

27 STORAGE RESERVOIRS ARE REQUIRED ON THE RIVERS OF NORTH BIHAR FOR MODERATION OF FLOOD, REGULATION OF STREAM FLOW AND FOR PERENNIAL IRRIGATION : ON THE RIVERS OF SOUTH BIHAR, FOR PROVIDING ASSURED IRRIGATION AND ON THE RIVERS OF CHOTANAGPUR, FOR GENERATION OF HYDEL POWER AND FOR SUPPLY OF WATER FOR INDUSTRIAL AND DOMESTIC USES.

(Paras. 15.3 and 11.3.6)

There is a need for storage reservoirs in those regions where stream flow either ceases entirely or is reduced to externely low values during part of the year.

Major rivers of North Bihar are notorious for carrying high flood discharge. Construction of storage reservoirs would not only moderate the flood but also regulate stream flow for ensuring perennial irrigation. But all the identified dam sites lie in Nepal. It is high time this matter is taken up with HMG Nepal and pursued vigorously to seek permission for undertaking the construction of storage reservoirs in the Nepalese territories on the rivers like Gandak, Kosi, Bagmati and Kamla .

The rivers of South Bihar are flashy and except during the monsoon season are practically dry. Assured irrigation in South Bihar is, therefore, not possible unless the diversion schemes are backed up by storage reservoirs. A number of small dams have either already been constructed or are under execution and several other dam sites have been identified on the lines of South Bihar for irrigation and power generation etc. This should be done within an overall perspective of basin development as a whole.

28 TRANSIT LOSES WHICH ARE ABOUT 50 PER CENT TO 60 PER CENT OF WATER DIVERTED INTO THE CANALS COULD BE REDUCED -

a BY LINING THE MAIN AND BRANCH CANALS.

b BY SETTING UP PROPER VILLAGE LEVEL ORGANISATION RESPONSIBLE FOR CHECKING WASTAGE OF WATER IN THE VILLAGE ROADS, CULVERTS AND OUTLETS.

c BY PREVENTING WASTEFUL USE OF WATER BY IRRIGATION THROUGH KIARIES, FURROWS AND SPRINKLERS (DEPENDING ON THE TYPE OF CROP, TOPOGRAPHY AND SOIL CONDITION).

d BY CONSOLIDATION OF HOLDINGS.

(Para 16.1)

Only about 50 per cent to 60 per cent of the water diverted into the canal from the river is available at the cultivators field for irrigating crops. The transit losses can be reduced by at least 80 per cent by lining the channels.

A considerable portion of the greatly reduced quantity of water that reaches the outlets is again lost by wastage into village roads and tanks due to poor maintenance and negligence in the operation of the water courses and field channels. This can be remedied effectively by the formation of proper organisations at village level responsible for the maintenance of water courses and field channels which is best done by a cooperative of the beneficiaries themselves.

Considerable saving in water can be effected in the field by dividing the field into 'Kiaries' with a separate inlet into each to avoid over irrigation of one part while trying to irrigate another through the same inlet. Irrigation by furrows and sprinklers would cause the least wastage and is worth serious consideration where water supply is scarce and the nature of crops grown justifies the additional cost and labour involved. Appropriate organisations of Water Resources Department should undertake the task of imparting training to the farmers to enlighten them in this regard.

Consolidation of holdings on the scientific lines would also require some considerable amount of water. This needs to be pursued vigorously as well.

29 a THE UPPER LIMIT OF DISCHARGING CAPACITY OF THE WATER COURSES SHOULD

BE FIXED AT FIVE CUSECS AND IT SHOULD END WHERE ITS DISCHARGE REDUCES TO ONE CUSEC.

b THE UPPER LIMIT OF THE DISCHARGING CAPACITY OF A FIELD CHANNEL SHOULD BE ONE CUSEC.

c THE SECTION OF WATERCOURSE SHOULD BE TELESCOPIC DOWN TO TWO CUSECS AFTER WHICH IT SHOULD CONTINUE WITH THE SAME SECTION IN ITS END.

(Para 16.2)

These recommendations should be implemented with the proviso that watercourses/field channels should end in drains, with appropriate tail end structures.

d WATER COURSES SHOULD BE CONSTRUCTED BY THE GOVERNMENT BUT SHOULD BE MAINTAINED AND OPERATED BY THE BENEFICIARIES WITH PART OF THE EXPENSES PROVIDED BY THE GOVERNMENT.

e THE FIELD CHANNELS SHOULD BE CONSTRUCTED AND MAINTAINED BY OR AT THE COST OF THE BENEFICIARIES IN ACCORDANCE WITH THE PROVISIONS OF BIHAR IRRIGATION FIELD CHANNELS ACT 1965.

(Para 16.2)

These recommendations should be reviewed by the 2nd Irrigation Commission.

30 CORRECT DOSAGE OF IRRIGATION TREATMENT REQUIRED BY DIFFERENT CROPS SHOULD BE DETERMINED.

If water available for irrigation is appreciably less than the need for proper growth and maturity of a crop, the yield becomes poor both in quantity and quality. On the other hand, excessive waterings are detrimental to both crops as well as to the land. It is, therefore, of utmost importance to determine the correct dosages of irrigation treatment both in quantum and frequency required by the different crops that can be grown economically with the help of artificial irrigation. The appropriate organisation of the State Government should undertake the task of disseminating the requisite knowledge in this regard among the farmers.

31 OPTIMUM WATER REQUIREMENT DAYS OF CROPS SHOULD BE SPREAD OUT SUFFICIENTLY TO ENABLE WATER SUPPLY AND TRANSMISSION SYSTEM TO COPE WITH THE DEMAND. TO ACHIEVE THIS, SOWING OF CROPS IN EACH SEASON SHOULD BE STAGGERED ANO DIVERSIFIEO.

(Para 18.8)

No irrigation system can supply water to all the fields in the command on a particular day or even in any particular week, should all the cultivators decide to sow high yielding or other such crops in their entire areas requiring irrigation at one and the same time.

Keeping this in view, therefore, the Commission had recommended that there must be adequate staggering and diversification of crops sown in each season. Only then the optimum water requirement days of such crops are spread out sufficiently to enable the water and transmission system to adequately cope with the demand. The enforcement of this recommendation appears to be difficult at present. However, farmers may be persuaded through extension services to adopt the designed cropping pattern so as to ensure proper implementation of this recommendation.

32 TO ENSURE GOOD LOAD FACTOR FOR POWER SUPPLY, IRRIGATION DEMANDS HAVE TO BE STAGGERED BY PROPER CROP PLANNING IN TUBEWELL IRRIGATION SYSTEMS.

(Para 18.8)

This recommendation is alright in principle and should be implemented. However, its implementation seems to be difficult/impossible under the present power position of the State.

33 FOR WATERSHED MANAGEMENTS STEPS TO BE TAKEN FOR AFORESTATION AND SOIL CONSERVATION MEASURES HAVE BEEN DETAILED IN PARA 19.3

(Para 19.3)

34 STEPS TO BE TAKEN FOR PREVENTING FLOODING AND WATERLOGGING IN THE PLAINS OF BIHAR HAVE BEEN DETAILED IN PARA 20.8.

(Para 20.8)

35 ADDITIONAL MEASURES TO BE TAKEN TO PREVENT WATERLOGGING IN AREAS PROVIDED WITH EXTENSIVE PERENNIAL IRRIGATION FACILITIES HAVE BEEN DETAILED IN PARA 20.9.

(Para 20.9)

The 2nd Irrigation Commission will go into details and make suitable recommendations.

FIELD PRACTICES OF IRRIGATION

36 THE EXISTING PRACTICE OF IRRIGATION BY FLOODING DAMAGES THE LAND, CAUSES SOIL EROSION AND LEADS TO WATERLOGGING AND SHOULD BE REPLACED BY METHODS WHICH ALLOW BETTER AND SCIENTIFIC WATER MANAGEMENT NEEDED FOR THE MAXIMUM PRODUCTION OF THE CROP. THE DIFFERENT METHODS OF IRRIGATION SUITED FOR THE DIFFERENT REGIONS AND FOR DIFFERENT CROPS AND SOIL CONDITIONS HAVE BEEN DETAILED IN CHAPTER 23.

(Para 23.3 and 23.8)

Irrigation practices currently in vogue in the State cause excessive loss of scarce irrigation water owing to imperfect water distribution and faulty method of water applications. This problem can be tackled successfully by utilising the available irrigation water, more efficiently and economically. Improved irrigation system chiefly depends on the methods of water application on scientific lines.

Scientific methods of water application as recommended by the First Irrigation Commission, such as (i) Border method (ii) Check method, (iii) Basin method, (iv) Furrow method (v) Sprinkler method etc are the standard methods and, therefore, should be adopted as far as possible with regard to available stream size, topography of the field, type of soil and other agronomic factors.

However, these methods cannot be employed efficiently unless the field drains are also constructed and consolidation of holdings between field drains and field channels are effected so that the plots could independently receive water from irrigation channels and escape excess water into field drains. Besides, proper training to create awareness among the farmers should be made to properly educate the farmers in water management practices with zeal and endeavour.

37 CULTIVATORS SHOULD BE ENCOURAGED TO LEVEL THEIR LAND FOR UNIFORM

DISTRIBUTION OF WATER OVER THE PLOT. ADEQUATE FACILITIES INCLUDING MACHINERIES AND LONG TERM LOANS SHOULD BE MADE AVAILABLE ON EASY TERMS. DEMONSTRATION SHOULD BE ARRANGED IN DIFFERENT AREAS FOR EDUCATION THE FARMERS.

(Para 24.3.1)

Land levelling and shaping in together with irrigation and drainage channels is essential for optimum utilisation of created irrigation potential. This is a major work and the farmers should be involved. Loan assistance for the purchase of their machines, tractors etc for the purpose of levelling and other agricultural works should be provided to small and marginal farmers to enable them to carry out these works on their own without any help/co-operation from the Government Agencies.

However, it is worthwhile to mention here that Command Area Development Agencies created for all round development of canal command areas are supposed to take appropriate actions for land development. But so far their activities seem to be confined mainly to construction of field channels. Somehow the land development programme of the Agencies have not been very popular. Incomplete irrigation system and absence of effective field drains may be prime reasons for non co-operation from the farmers.

38 IRRIGATION SHOULD BE TUNED TO THE MOISTURE DEFICIENCY IN THE ROOT ZONE. VOLUMETRIC SUPPLY OF WATER MAY BE GRADUALLY INTRODUCED.

(Para 22.2)

First Irrigation Commission made this recommendation in the light of facts that the existing irrigation methods as practiced in the State were not only uneconomic but harmful to crops also. Irrigation water should be applied to make up for the loss in soil moisture at appropriate intervals so that the crops make the most efficient use of water and furnish economic returns. Heavy and unwanted frequent applications of waterings increase losses of irrigation water and cause degradation of land and crops both. Contrary to this, delayed irrigation retards crop growth and development resulting in reduced yields.

It is imperative that cultivators should be made aware of the fact that the appropriate dosage and the frequency of irrigation and not the quantity of water are vital in increasing the crop yields.

The concerned organisations of the State may evolve norms for irrigation to be tuned with the moisture deficiency in the root zone and volumetric supply of water to the farmers.

39 TIME OF IRRIGATION APPLICATIONS SHOULD COINCIDE WITH THE CRITICAL STAGES OF CROP GROWTH.

(Para 23.9)

Efforts should be made to diversify critical stage demands of crops by designing the cropping pattern separately for different zones and for different types of fields in a canal command to meet the requirements with the available irrigation water. While it may be difficult to enforce the designed cropping pattern through legislations, cultivators may willingly adopt the prescribed cropping pattern if they are convinced that this is the most beneficial and economical under the prevailing circumstances.

40 SYSTEM OF PLOT TO PLOT IRRIGATION SHOULD BE DISCOURAGED AND CONSTRUCTION OF EVEN TEMPORARY FIELD CHANNELS SHOULD BE ENCOURAGED. INDIVIDUAL

FARMERS AND BENEFICIARY COMMITTEES SHOULD BE GIVEN ASSISTANCE FOR CONSTRUCTION OF FIELD CHANNELS.

(Para 28.8.3)

The prevalent system of irrigating crops from plot to plot is very expensive and harmful. The first plot where water enters from the village channel gets wet first, gradually going down the next plot till the last plot is irrigated. This results in excessive wastage of water due to over irrigation and deep percolation losses at the head and in-adequate supply to the plots at the far side resulting in loss of command area and damage to the crops in upper reaches due to over irrigation.

The First Irrigation Commission recommended for the construction of field channels to overcome this problem. It even recommended for the assistance to be given to individual farmers and beneficiary committee to facilitate the construction of field channels.

41 PROGRESSIVE AND EDUCATED FARMERS MAY BE INDUCED TO USE WATER MEASURING DEVICES, AND CHEAP BUT DURABLE STRUCTURES LIKE PLASTIC, SYPHDN, CANVAS, WOODEN OR IRON CHECK DAMS IN FIELD CHANNELS.

(Para 16.3 and 23.8.4)

42 FOR WATER DISTRIBUTIDN IN MORE THAN ONE DIRECTION, DIVERSION BOXES WITH SLIDING GATES SHOULD BE FIXED AT JUNCTIONS OF CHANNELS FOR WATER APPORTIONMENT.

(Para 16.3)

43 EROSION OF CHANNELS TAKES PLACE IN SLOPING TOPOGRAPHY WHERE STREAMS DROP SUDDENLY. TO MINIMISE THE IMPACT OF FALLING WATER, CHUTE OR DROPS WITHSTILLING WELLS SHOULD BE CDNSTRUCTED.

(Para 16.3)

44 FARMERS HAVING THEIR OWN FIELD CHANNELS MAY BE ENCOURAGED TO LINE THE KACHA CHANNELS WITH CHEAP LINING MATERIALS OR USE PIPES FOR CONVEYANCE OF WATER.

(Para 16.3)

45 CHANNELS CROSSING FARM ROAD, PUBLIC ROAD, SHOULD BE PROVIDED WITH INVERTED SYPHONS.

(Para 16.3)

Some means of measuring the flow should be employed at the points where water enters the system. Considerable saving of water can be effected in the field by dividing the fields into 'Kiaries' with a separate inlet into each to avoid over irrigation of one part while trying to irrigate another through the same inlet.

First Irrigation Commission recommended for the cheap but durable structures like plastic syphons, Canvas, Wooden or iron check dams in field channels.

To solve the problem of wastage of scarce irrigation water due to improper distribution systems, the Commission recommended use of small irrigation structures on the farm to divert, distribute

and to control irrigation water as soon as it reaches the farm premises. These recommendations should be implemented which are as follows:-

a For water distribution in more than one direction, diversion boxes with sliding gates should be fixed at junctions of channels for water apportionment.

b To minimise the impact of falling water in sloping topography, chute or drops with stilling wells should be constructed.

c Farmers having their own fixed channels may be encouraged to line the kacha channels with cheap lining materials or use pipes for conveyance of water.

d Channels crossing farm road, public road should be provided with inverted syphons.

46 WHERE WATER SUPPLY IS LIMITED OR WHERE SOIL IS VERY POROUS AND LAND UNDULATING, SPRINKLER SYSTEM OF IRRIGATION IS IDEAL IN REGULATION, DISTRIBUTION AND APPLICATION OF IRRIGATION, SPRINKLER IRRIGATION DOUBLES THE AREA UNDER IRRIGATION WITH THE SAME AMOUNT OF AVAILABLE SUPPLY.

(Para 23.7)

The First Irrigation Commission recommended the use of sprinkler irrigation in lands of porous soil and irregular topography where irrigation channels cannot be constructed at a low cost and where cost of land levelling is physically as well as economically not feasible.

The disadvantage in this method is that it is costly, needs power and it is not very efficient under high wind velocity conditions, but irrigation can be applied in calm atmosphere especially during night. This enables the farmers to concentrate on other works during day hours. This method is suitable for all field crops.

47 IN COMMANDS OF MAJOR IRRIGATION PROJECTS, THERE SHOULD BE ADEQUATE PROVISION FOR SURFACE DRAINAGE OR CONSTRUCTION OF TUBEWELLS BOTH FOR PROVIDING SUPPLEMENTAL IRRIGATION AND FOR LOWERING THE SUB-SOIL WATER TABLE. THE FARMERS HAVE ALSO TO BE GIVEN TRAINING IN PROVIDING ADEQUATE DRAINAGE FROM THEIR FIELDS.

(Para 24.2.3)

This is a very important recommendation and should be followed as far as possible. Drainage becomes necessary to safeguard against water logging and alkaline as well as saline intrusion in an irrigation command.

The First Bihar State Irrigation Commission also recommended provision of supplemental irrigation in Major irrigation projects with the help of tubewells, with twin objectives of irrigation & water level control.

48 COMMAND AREAS OF IRRIGATION PROJECTS SHOULD BE DIVIDED INTO ZONES ACCORDING TO AVAILABILITY OF WATER. CROPPING PATTERNS SHOULD BE WORKED OUT FOR THE DIFFERENT ZONES OF THE COMMAND AREAS AND FOR DIFFERENT TYPES OF LAND IN EACH ZONE BY TEAMS OF EXPERTS DRAWN FROM IRRIGATION, AGRICULTURE DEPARTMENT AND RESEARCH WORKERS FROM THE AGRICULTURAL UNIVERSITY.

(Paras 23.9 and 25.2.4)

Cropping pattern in the command of an irrigation project should taken into account the following factors:-

1 Nature of the land including its situation and soil type

2 Availability of water for irrigation purposes, and

3 Drainage facilities.

An irrigation command should be divided into different zones depending on the availability of water and drainage facilities and lands in each zone should further be classified into different groups. First Irrigation Commission recommended that cropping pattern should be carefully worked out separately for each group in the command by a team of experts from Agriculture and irrigation Departments and from Agriculture University as well. Different crop rotations for each of these groups in the command should be prescribed and efforts should be made to persuade the farmers to adopt the prescribed cropping pattern by imparting proper training and education.

49 RESEARCH IN WATER-MANAGEMENT AND LAND USE AND WATER USE SHOULD BE INTENSIFIED.

(Para 23.9)

50 INTENSIVE TRAINING PROGRAMME IN WATER-MANAGEMENT PRACTICES SHOULD BE ARRANGED FOR THE TRAINING OF IRRIGATION ENGINEERS, AGRICULTURAL EXTENSION OFFICERS AND FARMERS IN THE COMMAND AREAS OF ALL MAJOR IRRIGATION PROJECTS.

(Para 24.9)

Since research is a vital aspect of developmental activities, it is high time that due importance is given to the activities related with research in an organisation like Irrigation Department. Efficient water management, land use and water use are the needs of the day. Hence First Irrigation Commission recommended that intensive research in these should be undertaken.

First Irrigation Commission also recommended for intensive training programme in water management practices to Irrigation Engineers, Agricultural Extension Officers and farmers in an irrigation command.

The emphasis on enlightening the cultivators by providing for demonstration-cum-training camps, farmers discussion-cum- demonstration groups and regular training courses at farmers institute should be held.

51 AREA DEVELOPMENT PROGRAMME WILL HELP IN ACCELERATING THE PRODUCTION PROGRAMME. BESIDES KOSI COMMAND, THE PROGRAMME HAS BEEN INTRODUCED IN THE GANDAK AREA. THE PROGRAMME SHOULD BE EXTENDED TO SONE COMMAND INCLUDING THE TUBEWELL IRRIGATED AREAS OF PATNA AND GAYA DISTRICTS AND NORTH BHAGALPUR, NORTH MONGHYR AND DARBHANGA DISTRICT, GREATER EMPHASIS SHOULD BE GIVEN ON UTILISATION OF THE IRRIGATION POTENTIAL CREATED BY CONSTRUCTION OF FIELD CHANNELS THROUGH BENEFICIARY COMMITTEES. CROPPING PATTERNS SHOULD BE PRESCRIBED FOR DIFFERENT ZONES AND FOR DIFFERENT TYPES OF LAND AND INPUTS SHOULO BE MADE AVAILABLE TO FARMERS ON EASY TERMS AT SUITABLE POINTS NEAR THEIR FIELDS. CONSTRUCTION OF TUBEWELLS, BOTH STATE AND PUBLIC OWNED, AND LAND LEVELLING SHOULD FORM IMPORTANT ITEMS OF THE PROGRAMME. THE PROGRAMME SHOULD ALSO ENVISAGE TACKLING OF

SECOND GENERATION PROBLEMS LIKE PLANT DISEASES, MARKETING, STORAGE AND PROCESSING, ETC.

(Para 25.0)

This recommendation is already in the process of implementation. However, it is appropriate to mention here that there are four Area Development Agencies at present in Bihar. The ultimate objective of these Agencies were to bring about economic, social and educational development of the rural population. Hence their sphere of activities as originally envisaged are irrigation, drainage, flood control, water supply, rural electrification, land development, development of agriculture, animal husbandry, fisheries and development of social forestry etc.

But in actual practice their main activities have remained confined to field channels and that also without scientific consolidation of holdings and proper location of field drains. This State of affairs needs to be corrected immediately for optimum utilisation of hitherto created irrigation potential and field channels.

FINANCIAL ASPECT OF IRRIGATION WORKS

52 BEFORE COMMENCEMENT OF CONSTRUCTION WORK OF ANY PROJECT DETAILED INVESTIGATION, DESIGNS AND ESTIMATES OF THE PRINCIPAL WORKS AND ALSO CONSTRUCTION PLANNING AND PROCUREMENT OF EQUIPMENTS REQUIRED SHOULD BE COMPLETED.

(Para 29.1)

Water Resources Development Projects such as flood control, hydropower generation,water supply drainage soil conservation, etc are executed by different agencies of the State Government. This results in lack of comprehensive view and works taken up are completed keeping into account only the limited development. It is therefore, of utmost necessity that the projects should. as far as possible, be fully investigated, from all angles before being sanctioned and started only after complete construction planning, planning of men materials and equipments are completed.

Economy can be effected to a great extent if the projects are planned and prepared after proper investigation. Before commencement of construction work on any project, detailed investigation, designs, estimate of the principal works and also construction planning and procurement of equipments should be completed.

53 TO BE ABLE TO GET QUICK RETURNS FROM THE LARGE INVESTMENTS ON MAJOR IRRIGATION PROJECTS, THE PROGRAMME OF EXECUTION SHOULD BE DRAWN UP IN A PHASED MANNER, FROM THE HEAD-WORKS DOWNWARDS, AND COMPLETED IN ALL RESPECTS,IN SPECIFIED REACHES, BEFORE WORK IS TAKEN UP LOWER DOWN.

54 THE EXECUTION OF MAJOR AND MEDIUM PROJECTS SHOULD BE TAKEN UP IN ACCORDANCE WITH A PHASED PLAN CONSISTENT WITH THE PHYSICAL AND FINANCIAL RESOURCES THAT ARE EXPECTED TO BE AVAILABLE SO THAT THOSE TAKEN UP FOR EXECUTION ARE COMPLETED AND BROUGHT INTO OPERATION IN THE SHORTEST PRACTICABLE TIME AND BENEFITS AND REVENUE DERIVED THEREBY MAY BE HELPFUL IN FINANCING OTHER PROJECTS.

These recommendations are acceptable and should be strictly implemented. However, the 2nd Irrigation Commission may explore and devise ways and means for the enforcement of these recommendations.

55 TO PREVENT WASTEFUL EXPENDITURE, MAINTENANCE OF WATER-COURSES SHOULD BE ENTRUSTED TO BENEFICIARY COMMITTEES, WITH PART OF THE EXPENSES PROVIDED BY THE STATE GOVERNMENT AT RATES TO BE FIXED FROM TIME TO TIME.

56 AN ASSESSMENT OF THE INDIRECT REVENUE DERIVABLE BY THE STATE (IRRESPECTIVE OF WHETHER RECOVERIES ARE ACTUALLY MADE FROM THE CULTIVATORS OR NOT) AS THE RESULT OF INTRODUCTION OF IRRIGATION FACILITIES, SHOULD BE MADE BY CONDUCTING SOCIO-ECONONIC SURVEY OF IRRIGATED TRACTS AND ADJACENT UNIRRIGATED TRACTS. A SUITABLE PERCENTAGE (SAY 50 PER CENT) OF SUCH INDIRECT REVENUE SHOULD BE CREDITED, PROFORMA, TO THE FINANCIAL ACCOUNTS OF THE IRRIGATION PROJECTS WHEN ASSESSING THEIR FINANCIAL POSITION.

(Para 30.1.2)

57 WATER RATES SHOULD BE SO FIXED THAT THE INCOME DERIVED BY THE STATE GOVERNMENT FROM THIS SOURCE TOGETHER WITH PROFORMA CREDIT FOR IN DIRECT BENEFIT MENTIONED ABOVE SHOULD BE SUFFICIENT TO MEET THE WORKING EXPENSES OF ALL THE IRRIGATION PROJECTS AND ALSO THE INTEREST CHARGES. RATES SHOULD, HOWEVER, NOT EXCEED 8 PER CENT OF THE GROSS VALUE OF NORMAL PRODUCE ON IRRIGATED LANDS OR 30 PER CENT OF NET ADDITIONAL INCOME, DERIVABLE FROM THE LAND BY THE CULTIVATOR AS THE RESULT OF PROVISION OF IRRIGATION FACILITIES BY THE STATE, WHICHEVER IS GREATER.

(Para 30.1.3)

58 THE SYSTEM OF FILING 'SATTAS' OR APPLICATION FOR WATER SHOULD BE ABOLISHED AND ALL LANDS WHICH HAVE BENEFITED BY THE INTRODUCTION OF IRRIGATION SHOULD BE ASSESSED FOR PAYMENT OF WATER CHARGES.

(Para 31.5)

59 a ON SYSTEMS WITH ASSURED PERENNIAL IRRIGATIDN SUCH AS THE KOSI, THE GANDAK AND THE SONE, ETC.

AND

b ON SYSTEMS WHERE ONLY KHARIF IRRIGATION IS ASSURED FOR KHRIF SEASON, COMPULSORY WATER RATE SHOULD BE CHARGED FOR ENTIRE CULTURABLE COMMANDED AREA AT 2/3RD KHARIF RATE LEVIAVLE ACCORDING TO THE PRINCIPLES LAID DOWN. FOR RABI AND HOT WEATHER SEASONS, IRRIGATIDN MAY BE VOLUNTARY AND CHARGED FOR AREA ACTUALLY IRRIGATED AT FULL RATES OF RABI AND HOT WEATHER SEASONS ACCORDING TO THE PRINCIPLES LAID DDWN.

C ON SYSTEMS, WHERE SUPPLY IS NDT ASSURED IN ANY SEASON IRRIGATION MAY BE VOLUNTARY IN EACH CROP SEASON AND CHARGED FOR THE AREA ACTUALLY IRRIGATED WITH SUITABLY REDUCED WATER RATE.

(Para 31.6.1)

60 RESPONSIBILITY FOR CDLLECTION OF WATERRATES MAY BE TRANSFERRED TO THE REVENUE DEPTT, IF FOUND FEASIBLE AND EXPEDIENT. ASSESSMENT SHOULD BE THE RESPONSIBILITY OF THE DIVISIONAL ENGINEER OF THE IRRIGATION DEPARTMENT AND HE SHOULD BE THE FINAL AUTHDRITY TO PASS ORDERS DN OBJECTIONS TO ASSESSMENT.

(Para 31.7 and 31.8)

61 WATER RATE SHOULD BE REVIEWED AT INTERVALS OF FIVE YEARS AND ADJUSTED UPWARDS OR DOWNWARDS ON THE BASIS OF THE PRINCIPLES SUGGESTED.

(Para 31.9)

62 SINCE THE ABOVE CHANGES WOULD INVOLVE CAREFUL STUDY OF THE EXISTING LAWS AND RULES ON THE SUBJECT, AND AS THESE CAN BE BROUGHT ABOUT ONLY AFTER SUITABLE LEGISLATIVE CHANGES AND CORRESPONDING CHANGES IN THE RULES THEREUNDER HAVE BEEN MADE, A WHOLETIME OFFICER SHOULD BE DETAILED TO EXAMINE THESE RECOMMENDATIONS OR SUCH OF THEM AS MAY BE ACCEPTED BY THE GOVERNMENT WITH A VIEW TO GIVING CONCRETE SHAPE AND TO WORK OUT DETAILS OF THE ACTION REQUIRED TO BE TAKEN TO IMPLEMENT THESE.

(Para 31.10)

63 IT HAS BEEN RECOMMENDED THAT WATER RATES WITH THE PROFORMA INDIRECT BENEFITS SHOULD BE SUCH AS TO MEET THE FULL COST OF PROVIDING IRRIGATION FACILITY INCLUDING THE INTEREST CHARGES. IF THESE RECOMMENDATIONS ARE GIVEN EFFECT TO, THERE COULD BE NO JUSTIFICATION FOR A BETTERMENT LEVY ON ACCOUNT OF INTRODUCTION OF IRRIGATION FACILITIES IN ANY TRACT OR FIELD.

(Para 32.7)

These recommendations should be reviewed by the 2nd Irrigation Commission and suitable recommendations made.

ORGANISATIONAL AND ADMINISTRATIVE SET-UP FOR PLANNING AND EXECUTION OF IRRIGATION WORKS.

64 DEVELOPMENT OF WATER RESOURCES OF THE STATE CAN BE SUCCESSFULLY IMPLEMENTED UNDER A UNIFIED SET-UP. THE DEVELOPMENT OF IRRIGATION (MAJOR, MEDIUM AND MINOR) FOR THE WHOLE STATE INCLUDING THE IRRIGATION WORKS AT PRESENT ENTRUSTED TO THE RIVER VALLEY PROJECTS DEPARTMENT AND THE AGRICULTURE DEPTT. (STATE-OWNED MINOR IRRIGATION WORKS) SHOULD BE TAKEN UPTHROUGH ONE DEPARTMENT. IE THE IRRIGATION DEPARTMENT FOR MAJOR PROJECTS SEPARATE WINGS MAY BE SET-UP WITHIN THE IRRIGATION DEPARTMENT. THE ENGINEERING CADRES OF THE DEPTTS. CONCERNED SHOULD ALSO BE AMALGAMATED.

(Para 35.0)

65 MINOR IRRIGATION WORKS INCLUDING THE STATE TUBEWELL SYSTEMS WHICH ARE TO BE EXECUTED AND MAINTAINED BY THE GOVERNMENT FOR WHICH WATER RATES ARE TO BE REALISED SHOULD BE MANAGED BY THE UNIFIED IRRIGATION DEPARTMENT. THE REST OF THE MINOR IRRIGATION WORKS WHICH ARE TO BE EXECUTED ON BEHALF OF THE BENEFICIARIES OR PANCHAYATS AND ARE TO BE HANDED OVER TO THEM FOR MAINTENANCE SHOULD BE EXECUTED BY THE STAFF OF IRRIGATION DEPARTMENT ON DEPUTATION TO THE AGRICULTURE DEPARTMENT AND KEPT UNDER THE ADMINISTRATIVE CONTROL OF THE CHIEF ENGINEER, MINOR IRRIGATION, AGRICULTURE DEPARTMENT

(Para 41.0)

These recommendations have partially been implemented by the creation of a unified water

Resources Department which includes Minor Irrigation as well as However, these recommendations may further be studied by the 2nd Irrigation Commission.

66 IN THE UNIFIED SET-UP OF THE IRRIGATION DEPARTMENT INVESTIGATION AND PLANNING OF THE MAJOR AND MEDIUM IRRIGATION SCHEMES FOR THE STATE SHOULD BE CENTRALISED IN AN INVESTIGATION AND PLANNING ORGANISATION WITH A SEPARATE CHIEF ENGINEER INCHARGE OF THE ORGANISATION.

(Para 36.1)

Investigation and planning wing under a Chief Engineer has already been created within the water Resources Department which appears to have been done on the lines of this recommendation.

67 THE DESIGN AND RESEARCH ORGANISATION NOW UNDER THE IRRIGATION AND THE RIVER PROJECTS DEPARTMENT SHOULD BE CENTRALISED IN A DESIGN AND RESEARCH ORGANISATION IN THE UNIFIED IRRIGATION DEPARTMENT.

(Para 37.1.3)

This recommendation has already been implemented but slightly in different form. This may further be studied and examined by the 2nd Irrigation Commission.

68 IMPROVEMENTS TO BE BROUGHT ABOUT IN THE DESIGNS AND RESEARCH ORGANISATION HAVE BEEN DETAILED IN PARAS 37.1.4 AND 37.2.2.

(Para 37.1.4 and 37.2.2)

The First Bihar Irrigation Commission made following specific recommendations for bringing about improvement in the working of the Design Organisation.

1 The Central Design Organisation, with the design and drawing office, library, etc should preferably be housed in the same premises to facilitate Design Engineers of the rank of Assistant Engineers and below to work out the designs and prepare the drawings themselves, instead of depending on the draftsmen and tracers. Dependence on draftsmen and tracers should be reduced to the minimum. The design offices should be manned mostly by Graduate Engineers. The Graduate Engineers posted to the designs organisation should have good academic record, preferably postgraduate qualifications and special aptitude for engineering theory and designs of structures, adequate field experience and should be given special training by deputing them for postgraduate training at Water Resources Department Training Centre, Roorkee or other equivalent and recognised training institute or university.

2 Design manual should be printed and provided to all Design Engineers. Standard design criteria for different types of works and typed design of structures such as falls, regulators, local drainage syphons, etc, should be prepared to reduce labour put in design of typical structures.

3 A Central Designs Library should be set up. Adequate annual grants should be given to procure reference books publications and journals to keep the Design Engineers in touch with the latest trend of development in Engineering Theory and practice. The existing engineering books now kept with the different designs organisation should be collected and kept in this library.

4 Calculating machines should be provided in the design office to reduce the time spent in making protracted calculations.

5 Design Engineers should keep themselves fully in touch with the field conditions of the

projects and works under design and should be required to visit the site whenever necessary. They should also be sent to visit the Central design office of the Central Water and Power Commission and other States is study design methods and procedure adopted by their organisations.

Following specific recommendations were made by the First Irrigation Commission for improvement of the Irrigation Research Organisation in the State.

1 The Director of the Bihar institute of Hydraulic and Allied Research should be an Engineer preferably with postgraduate qualification and with good academic record and research experience and with aptitude for research work, He might preferably be of the age-group (40-45), so that he may be able to serve the institute for a fairly long period to bring about improvements in the standard of the institute. He should also have had sufficient experience on irrigation works. He should be required to visit the important research stations of the country to get himself acquainted with the latest trend of Engineering Research, so that he may be competent to prepare and execute plans for development and expansion of the institute to cater to the needs of engineering research in the State.

2 The Engineers posted to the Research institute should be drawn from the Engineering cadres of the Department and should have good academic background and aptitude for research work. Engineers should be posted to the Research institute for a minimum period of 5 years. It should also be ensured that their interest in the cadre does not suffer because of their being for long years in the Research institute.

3 About 50per cent of the posts of Research Dfficers in charge of research sections may be filled up by Science Graduates with good academic record and preferably with postgraduate qualifications in subjects connected with the type of research work to be entrusted with. The rest may be drawn from competent engineers preferably with post graduate qualifications and good academic record as well as some design experience. Science graduates may be recruited at the level of Research Assistants and after experience. Promoted to the post of Research Officer subject to the suitability and availability of posts. They should be encouraged to take engineering degrees of Corporate Membership of recognised engineering institutions in the subjects pertaining to their work. There after they can be given some field experience and subject to good record of work, they should be treated at par with engineers for the posts in the Research and Drainage Organisations to be filled by Engineers.

4 The Director, Deputy Directors, Research Officer should be encouraged to publish papers on their works and should be allowed to participate in the Research seminars of the Central Board of Irrigation and Power and other all India Research Organisations.

5 The work of Research personnel, whether individual or by groups should be suitably recognised if research work of merit carried out by them is published in the reputed engineering journals of the country or abroad. Out standing research work should be given special appreciation by special mention in the records of the personnel concerned, appreciative certificates from the Government and by the grant of special increments in pay etc.

6 The Bihar Institute of Hydraulic and Allied Research should be equipped and manned properly to ensure that no research problem except a few very complicated or unusual ones have to be referred to outside research institutes.

7 The Research Officer of the River Valley Projects Department should be brought into the cadre of Research Officers (Non-Engineers) of the Bihar Institute of Hydraulic and Allied Research.

8 There should be adequate provision for research and designs both under the head establishment as well as under works, in the construction estimates of each project and also in

the annual maintenance and operation estimates of major canal systems. The cost of regular establishment required in the research organisation should be met out of the total provision under the establishment for research and designs in the estimates mentioned above for which specific budget provision should be made in the annual budgets. The works cost on research in respect of problems referred to the research institute (such reference should be compulsory in respect of design, construction or operation problems requiring hydraulic, structural model experiments, properties of materials to be used for construction, quality control etc.) should be debited to the provision under "works" for research in the estimates mentioned above.

No work charged establishment should be employed in the research organisation, but the strength of the regular establishment should be suitably increased to cope with all the research works to be carried out. The cost of establishment can be suitably distributed amongst the various projects under construction or operation in proportion to the respective budget provisions under "research". The work charged establishment at present employed in the research organisation should, subject to suitability for the particular category of work to be performed, have first preference for absorption against the additional regular establishment posts to be created in accordance with these recommendations.

9 Great care should be taken to select and post to the design and research organisation the best talents with special aptitude for designs and research along with adequate and satisfactory record of field experience. It there is any tendency to look upon research work as unimportant or fit only to be entrusted to personnel who are not suitable for field work, such attitude should be given up. The work of research and designs personnel specially selected for these organisation should be recognised by the grant of adequate special pay. Personnels found unsuitable for this type of work should not be retained in this organisation.

10 There should be a suitable provision for 'Research and Design' in the construction estimates of each project and also in the maintenance, and operation estimates of major canal systems. The cost of all problems referred to the Research Institute (such preference should be compulsory in respect of design, construction or operation problems requiring hydraulic or structural model tests, quality control, etc) should be debited to this provision.

A few of the above recommendations, like merger of research officers of the then River Valley Projects Department in the cadre of the Irrigation Research Institute, have been implemented. All the recommendations are worth acceptance. The implementation of these recommendations requires to be strictly enforced.

69 IRRIGATION COMMISSIONER-CUM-SECRETARY TO GOVERNMENT SHOULD BE IN OVERALL CHARGE OF THE UNIFIED IRRIGATION DEPARTMENT. HE SHOULD BE ASSISTED BY THE ENGINEER-IN-CHIEF-CUM-ADDITIONAL SECRETARY TO GOVERNMENT.

(Para 42.1)

This recommendation has already been implemented.

70 THE ENGINEER-IN-CHIEF IN THE CAPACITY AS THE TECHNICAL HEAD OF THE UNIFIED IRRIGATION DEPARTMENT WHO WILL NOT BE IN DIRECT CHARGE OF EXECUTION OF WORKS WILL BE RESPONSIBLE FOR ADVISING THE GOVERNMENT ON MATTERS OF POLICY TO BE ADOPTED FOR THE DEVELOPMENT OF IRRIGATION IN THE STATE. HE WILL ALSO DEAL WITH OTHER TECHNICAL MATTERS AT THE SECRETARIAT LEVEL.

(Para 38.4)

This recommendation has already been implemented. Against the recommendation for the creation

of the post of an Engineer-in-Chief, the department has created the posts of three Engineer-in-Chiefs out of which two are Additional commissioner-cum-Special Secretaries. According to recommendation, their responsibility was to advise the government on matters of policy to be adopted for the development of irrigation in the State, But in actual practice, they are getting gradually involved in day to day works and activities of the fields also. This aspect of the state of affairs deserves to be reexamined by the 2nd Irrigation Commission.

71 A WATER RESOURCES BOARD SHOULD BE SET UP IN THE STATE TO CONTROL THE OVERALL PLANS FOR IRRIGATION HYDEL POWER, FLOOD CONTROL, NAVIGATION, INDUSTRIAL AND DOMESTIC WATER SUPPLY, PREVENTION OF WATER POLLUTION, PISCICULTURE AND WATERSHED MANAGEMENT. THIS AGENCY SHOULD BE RESPONSIBLE FOR PUBLISHING AND DISSEMINATING HYDROLOGICAL AND METEOROLOGICAL DATA FOR PLANNING AND COORDINATING THE ACTIVITIES OF THE VARIOUS AGENCIES WORKING IN THIS FIELD.

The recommendation may be reviewed by the 2nd Irrigation Commission.

72 SUGGESTIONS HAVE BEEN DETAILED FOR EFFICIENT EXECUTION OF IRRIGATION WORKS IN CHAPTER 46. THE SUBJECTS DEALT WITH INCLUDES PLANT ANO MACHINERY, CONSTRUCTION MATERIALS, TENDERS, AGREEMENTS, CLASSIFICATION AND REGISTRATION OF CONTRACTORS, EARNEST MONEY AND SECURITY DEPOSIT, ESTIMATES, SCHEDULE OF RATE, DELEGATION OF POWER, PRE-CHECK SYSTEM, DEPARTMENTAL EXECUTION OF WORKS, DEPARTMENTAL WORKSHOP, INCENTIVE BONUS SYSTEM, COST ACCOUNTING SYSTEM, WORKLOAD FOR EXECUTION OF IRRIGATION WORKS (CHAPTER 44). AMENITIES TO LABOURS, WORK-CHARGEO ESTABLISHMENT, ENGINEERS TRAINING, DEPARTMENTAL EXAMINATION, SERVICE CONDITIONS OF ENGINEERS (CHAPTER 45).

Many suggestions under this recommendation have already been implemented. However, this further needs to be reviewed by the 2nd Irrigation Commission.

बिहार सरकार
जल संसाधन विभाग

पटना, दिनांक 15-02-91

पत्रांक-। पी.एम.सी./एम/60/86-268

प्रेषक,

सरकार के संयुक्त सचिव
जल संसाधन विभाग, पटना।

सेवा में,

महालेखाकार, बिहार,
रॉची/पटना।

अनौपचारिक रुप से परामर्शित द्वारा: वित्त विभाग

विषय: द्वितीय बिहार राज्य सिंचाई आयोग का गठन।

महाशय,

निदेशानुसार सूचना करना है कि पिछले दशक में सिचाई एवं बाढ़ नियंत्रण की बढ़ती हुई समस्याऐं, तकनीकी प्रगति एवं विशेषज्ञ समितियों की अनुशंसाओं के सन्दर्भ में बिहार की सिंचाई एवं बाढ़ समस्याओं सम्यक अध्ययन के लिए राज्य सरकार ने द्वितीय बिहार राज्य सिंचाई आयोग के गठन का निर्णय लिया है।

2. इस आयोग के अध्यक्ष मंत्री, जल संसाधन होंगे। आयोग के सदस्यों की सूची परिशिष्ट-1 पर संलग्न है।

3. आयोग के स्थापना पर वार्षिक व्यय 13,21,000/- (तेरह लाख एक्कीस हजार) रुपये होंगे जिसका ब्यौरा परिशिष्ट–II पर संलग्न है।

4. आयोग के विचारणीय विषय परिशिष्ट–III पर संलग्न है।

5. आयोग में दो पद (2 पद) अभियंता प्रमुख एवं एक पद (1 पद) मुख्य अभियंता का है जिसमें से एक पद पर वर्तमान में कार्यरत बिहार राज्य योजना पर्षद के सदस्य (अभियंत्रण) को रखा जाएगा।

6. मुख्य अभियंता इस आयोग के सदस्य सचिव होंगे।

7. आयोग में एक अर्थशास्त्री (मुख्य अभियंता के स्तर का) एवं एक कृषि विशेषज्ञ (मुख्य अभियंता के स्तर का) होंगे।

8. आयोग के लिये जो भी पद स्वीकृत किये जाऐगे उनके वार्षिक व्यय के समतुल्य पदों को जल संसाधन विभाग अवेयेन्स में रखेगा या अस्थायी रुप से सरेन्डर कर देगा जिससे कि राज्य सरकार को अतिरिक्त वित्तीय भार वहन नहीं करना पड़ेगा।

9. सदस्यों के लिये नये वाहन क्रय नहीं किये जाएगें एवं जल संसाधन विभाग सदस्यों को विभाग से वाहन उपलब्ध करायेगा। आयोग के सरकारी सदस्य बिहार सरकार के यात्रा भत्ता नियमावली के अनुसार यात्रा भत्ता एवं दैनिक भत्ता प्राप्त कर सकेंगे, जो उन्हें अपने विभाग से प्राप्त होगा। आयोग के गैर सरकारी अंशकालीन सदस्य भी राज्य सरकार के प्रथम श्रेणी के पदाधिकारियों के अनुमान्य यात्रा भत्ता एवं दैनिक भत्ता प्राप्त कर सकेंगे। पूर्णकालीन सदस्य नियुक्ति के समय सरकार द्वारा स्वीकृत दर पर वेतन, यात्रा भत्ता, दैनिक भत्ता इत्यादि प्राप्त कर सकेंगे। गैर सरकारी सदस्यों की यात्रा भत्ता के मामले में सदस्य सचिव नियंत्रण पदाधिकारी होंगे।

10. आयोग गठन से दो वर्षों के अन्दर अपना प्रतिवेदन देगा। परन्तु तत्काल मार्च, 91 तक इसका सृजन किया गया है।

11. आयोग का मुख्यालय पटना में रहेगा।

12. आयोग पर व्यय मुख्य शीर्ष "4701" वृहत एवं मध्यम सिंचाई परियोजनाओं पर पूंजीगत परिव्यय-80-सामान्य–अन्य क्षेत्रीय उपयोजना–800–अन्य व्यय" के अन्तर्गत भारित होगा।

अनु०: यथा कथित
परिशिष्ट– I,II,III

विश्वास भाजन

ह०/–
सरकार के सँयुक्त सचिव

पत्रांक I/एम.सी/एम/60/86-268 पटना, दिनांक 15-2-91।

प्रतिलिपि अनुलग्नक की प्रति के साथ मुख्य मंत्री के प्रधान सचिव/मंत्री, जल संसाधन के आप्त सचिव/राज्य मंत्री, जल संसाधन के आप्त सचिव/उप मंत्री, जल संसाधन के आप्त सचिव/आयुक्त एवं सचिव, जल संसाधन विभाग/अभियंता प्रमुख–सह–अपर आयुक्त–सह–विशेष सचिव (श्री आई एन सिन्हा)/अभियंता प्रमुख (श्री आर एन पी सिन्हा)/सभी मुख्य अभियंता, जल संसाधन विभाग/वित्तीय परामर्शी–सह–मुख्य लेखा पदाधिकारी, प्रशाखा–20/अधीक्षण सम्पर्क कार्यालय, एम–13, साकेत, नई दिल्ली को सूचनार्थ एवं आवश्यक कार्रवाई हेतु प्रेषित।

अनु०: परिशिष्ट– I, II एवं III

ह०/–
सरकार के संयुक्त सचिव

पत्रांक 1/पी.एम.सी./एम/60/86— 268 पटना, दिनांक 15-2-91

प्रतिलिपि अनुलग्नक की प्रति के साथ वित्त विभाग, बिहार, पटना/योजना बिहार, पटना को सूचनार्थ एवं आवश्यक कार्रवाई हेतु प्रेषित।

अनु०: परिशिष्ट– I, II एवं III

ह०/–
सरकार के संयुक्त सचिव

पत्रांक 1/पी.एम.सी./एम/60/86— 268 पटना, दिनांक 15-2-91

प्रतिलिपि अनुलग्नक की प्रति के साथ आयोग के सभी सदस्य को सूचनार्थ एवं कार्रवाई हेतु प्रेषित।

अनु०: परिशिष्ट– I, II एवं III

ह०/–
सरकार के संयुक्त सचिव

बिहार सरकार
जल संसाधन विभाग

संकल्प

विषयकः द्वितीय सिंचाई आयोग का गठन।

पिछले दशक में सिंचाई प्रबंधन एवं बाढ़ नियंत्रण से संबंधित बढती हुई समस्याओं के निदान हेतु तकनीकी प्रगति को ध्यान में रखते हुए, राज्य सरकार ने बिहार के जल संसाधन के बेहतर उपयोग/प्रबंधन आदि के लिए द्वितीय सिंचाई आयोग का गठन करने का निर्णय लिया है।

2. **द्वितीय सिंचाई आयोग में निम्नांकित सदस्य होंगे -**

1.	मंत्री, जल संसाधन विभाग, बिहार, पटना	अध्यक्ष
2.	जल संसाधन विकास विशेषज्ञ (अभियंता प्रमुख के स्तर का)	पूर्णकालिक सदस्य
3.	सिंचाई प्रबंधन विशेषज्ञ (मुख्य अभियंता के स्तर का)	पूर्णकालिक सदस्य
4.	बाढ़ प्रबंधन विशेषज्ञ (अभियंता प्रमुख के स्तर का)	पूर्णकालिक सदस्य
5.	अर्थशास्त्री (मुख्य अभियंता के स्तर का)	पूर्णकालिक सदस्य
6.	कृषि विशेषज्ञ (मुख्य अभियंता के स्तर का)	पूर्णकालिक सदस्य
7.	सदस्य (जल आयोजन) केन्द्रीय जल आयोग, भारत सरकार	अंशकालिक सदस्य
8.	कृषि उत्पादन आयुक्त, बिहार	अंशकालिक सदस्य
9.	ग्रामीण विकास आयुक्त, बिहार	अंशकालिक सदस्य
10.	भूमि सुधार आयुक्त, बिहार	अंशकालिक सदस्य
11.	आयुक्त एवं सचिव, जल संसाधन विभाग, बिहार	अंशकालिक सदस्य
12.	आयुक्त एवं सचिव, ऊर्जा विभाग	अंशकालिक सदस्य
13.	सचिव, वन एवं पर्यावरण विभाग, बिहार	अंशकालिक सदस्य
14.	अभियंता प्रमुख–सह–अपर आयुक्त–सह–विशेष सचिव, जल संसाधन विभाग	अंशकालिक सदस्य
15.	अभियंता प्रमुख, मध्य बिहार, जल संसाधन विभाग	अंशकालिक सदस्य
16.	अभियंता प्रमुख, उतर बिहार, जल संसाधन विभाग	अंशकालिक सदस्य
17.	उपभोक्ताओं के एक प्रतिनिधि (मनोनयन बाद में किया जाएगा)	अंशकालिक सदस्य
18.	समाजसेवी संस्थानों की एक प्रतिनिधि (मनोनयन बाद में किया जाएगा)	अंशकालिक सदस्य
19.	निदेशक, अनुग्रह नारायण सिन्हा इन्टीच्यूट, पटना या उनके प्रतिनिधि	अंशकालिक सदस्य
20.	निदेशक, जल संसाधन विकास केन्द्र, बिहार कॉलेज ऑफ इन्जिनियरिंग, पटना	अंशकालिक सदस्य

3. पांच पूर्णकालिक सदस्यों में से एक सदस्य (मुख्य अभियंता के स्तर के) द्वितीय सिंचाई आयोग के सदस्य सचिव के रुप में कार्य करेंगे। आयोग के सचिवालय की सुविधायें जल संसाधन विभाग द्वारा उपलब्ध करायी जायेगी। सदस्य सचिव का प्रतिनियुक्ति के लिए अलग से आदेश निर्गत किया जा रहा है।

4. द्वितीय सिंचाई आयोग के विषयों की सूची परिशिष्ट–3 पर द्रष्टब्य है। आयोग का प्रतिवेदन दो वर्षो के अन्दर राज्य सरकार को समर्पित किये जाने का प्रावधान दिया गया है। इस आयोग पर होने वाले वार्षिक व्यय 13.21 लाख रुपये आंकलित किया गया है जिसकी विवरणी परिशिष्ट–2 पर द्रष्टब्य है।

5. आयोग के गठन के फलस्वरुप राज्य सरकार को कोई अतिरिक्त व्यय वहन नहीं करना है। इसके लिए जल संसाधन विभाग में रिक्त पदों को आयोग के कार्यकारी अवधि तक अस्थायी रुप से प्रत्यावर्तित कर लिया जायेगा अथवा "अवेयेन्स" में रखा जायेगा।

4. आयोग के सदस्यों एवं सदस्य सचिव की सहायता के लिए जल संसाधन विभाग में उपलब्ध पदों में से आवश्यकतानुसार अनुसचिवीय पद उपलब्ध कराये जायेंगे, जिसका विवरण परिशिष्ट–2 में अंकित है।

आदेश :– आदेश दिया जाता है कि इस संकल्प को बिहार राजपत्र के असाधारण अंक में तुरंत प्रकाशित किया जाय और इसकी सूचना सरकार के सभी विभाग/सभी विभागाध्यक्ष/सभी संबंधित सदस्यों को दी जाय।

अनु०: परिशिष्ट 1, 2 एवं 3

बिहार राज्यपाल के आदेश से

(ह० शान्ति नाथ झा)
सरकार के संयुक्त सचिव

ज्ञापांक–5/एम-1-202/91-829/ पटना, दिनांक 6-3-91

प्रतिलिपि अधीक्षक, राजकीय मुद्रणालय, गुलजारबाग, पटना को सूचना एवं आवश्यक कार्रवाई हेतु प्रेषित।

2. अनुरोध है कि उक्त संकल्प को बिहार राजपत्र के असाधारण अंक में प्रकाशित करवाने की कृपा की जाय तथा इसकी 100 प्रतियाँ इस विभाग को भेज दें।

(ह० शान्ति नाथ झा)
सरकार के संयुक्त सचिव

ज्ञापांक–5/एम-1-202/91-829/ पटना, दिनांक 6-3-91

प्रतिलिपि सभी विभाग/सभी विभागाध्यक्ष/सभी संबंधित सदस्यों (पदनाम से) को सूचना एवं आवश्यक कार्रवाई हेतु प्रेषित।

(ह० शान्ति नाथ झा)
सरकार के संयुक्त सचिव

ज्ञापांक–5/एम-1-202/91-829/ पटना, दिनांक 6-3-91

प्रतिलिपि महालेखाकार, पटना/राँची को विभागीय पत्रांक 268 दिनांक 15-2-91 के क्रम में सूचनार्थ एवं आवश्यक कार्रवाई हेतु अग्रसारित।

(ह० शान्ति नाथ झा)
सरकार के संयुक्त सचिव

LIST OF SPECIAL INVITEES

1 Chairman, Ganga Flood Control Commission (GOI)

2 Secretary, Water Resources (Minor Irrigation) Department, Bihar

3 Chairman, SCADA, Patna

4 Chief Engineer, Advance Planning, Patna

5 Chief Engineer, Planning & Monitoring, Patna

6 Director, WALMI, Khagaul, Patna

7 Joint Secretary, Personnel Management Cell, WRD, Patna

8 Superintending Engineer, Flood Control and Design Circle, Patna

9 Superintending Engineer, Planning & Monitoring Circle 5, WRD, Patna

10 Director, Statistics & Evaluation, Patna

11 Director, Hydrology Cell, WRD, Patna

12 Superintending Engineer, Planning & Monitoring Circle 1, WRD, Patna

13 Director, Ground Water Directorate, Bihar, Patna

14 Dr M N Singh, Geologist, Bihar State Planning Board, Patna

15 Sri R B Sharma, Engineer-in-Chief (Rtd), WRD

16 Sri D N Mehta, Superintending Engineer (Rtd), WRD.

17 Sri S N Singh, Agriculture Specialist

Appendix IV

LIST OF OFFICERS ATTACHED WITH THE SECOND BIHAR STATE IRRIGATION COMMISSION

Sl No	Name and Designation	Period	Remarks
Superintending Engineer			
Master Planning & Design Circle 3			
1	Sri Sirajuddin Ahmed	Upto 24.2.92	
2	Sri Ved Bhushan Bhagat	24.2.92 to 11.2.93	
3	Sri Shashi Shekhar Singh	11.2.93 to 28.10.93	
4	Sri Gagan Prasad	28.10.93 to 17.11.93	
5	Sri Satyapal Soni	18.11.93 to 31.12.93	
6	Sri Md Ahmed	27.1.94 till end	
Executive Engineers			
(Master Planning & Design Circle 3, Division 7 & 8)			
1	Sri Bimal Prasad Choudhary	Full term	
2	Sri Shyamdeo Rai (T A)	Upto 3.2.94	
3	Sri Sheo Shanker Khan	Upto 16.7.92	
4	Sri Shyam Sunder Pd Singh	17.7.92 till end	
5	Sri Indranan Singh (T A)	4.2.94 till end	
6	Sri Narendra Nath Singh	8.7.94 till end	
Assistant Engineers			
(Master Planning & Design Circle 3, Division 7 & 8)			
1	Sri Bipin Bihari Mishra	Full term	Computerisation of Report & Drganisational Matters
2	Sri Ashok Kumar Prasad	Full term	Computerisation of Report & Policies & Programme
3	Sri Ramesh Kumar	Full term	Interstate Agreement, Policies & Programme
4	Sri Anil Kumar Sinha	Full term	Basin Planning & Basin Maps
5	Sri Kedar Prasad Singh	Full term	Interstate Agreement & Draft Irrigation Act
6	Sri Harish Kumar	Full term	Basin Planning
7	Sri Madan Mohan Gupta	Full term	Basin Planning
8	Sri Vinod Kumar	Full term	Meetings & Misc.
9	Sri Chandra Bhan Singh	Upto 15.3.94	Misc.
10	Sri Ashok Kumar	Upto 28.7.92	Misc.
11	Sri Nand Kishor Prasad	Upto 22.7.92	Misc.
12	Sri Birendra Kumar Ram	Upto 22.7.92	Misc.
13	Sri Birendra Kumar Sinha	Upto 15.7.92	Misc.
14	Sri Bijendra Kumar Ram	Upto 15.7.92	Misc.
15	Sri Ram Krishna Prasad	Upto 21.2.92	Misc.
16	Sri Parmanand Jha 'Pawan'	Upto 1.6.92	Misc.
17	Sri Basudeo Prasad Sharma	20.1.92 to 19.7.93	Library
18	Sri Ajit Kumar Samaiyar	Feb 92 till end	Post-facto evaluation of projects & Flood and drainage problems
19	Sri Bibhuti Nath Jha	1.7.92 till end	Flood & drainage problems
20	Sri Suresh Kumar	12.8.92 till end	Data Processing, Basin Planning and Basin Maps
21	Sri Janki Prasad Ghosh	10.8.92 till end	Financial Aspects
22	Sri Manoranjan Swaroop	2.2.93 till end	Basin Planning
23	Sri Bipin Kumar	12.7.93 till end	Basin Planning, Maps and General Report
24	Sri Jatadhari Singh	1.3.93 till end	Financial Aspects
25	Sri Shambhu Prasad	Aug 93 till end	Basin Planning
26	Sri Vedakant Pathak	Aug 93 till end	Basin Planning

MEMBERS OF THE SUB-COMMITTEES OF THE COMMISSION

Sub-committee 1 (For TOR 1 and 3)

1	Chairman	Sri Saryu Rai, Part-time Member, Second Bihar State Irrigation Commission
2	Member	Secretary, Water Resources Department, Patna
3	"	Secretary, Land Reforms Department, Patna
4	"	Secretary, Agriculture Department, Patna
5	"	Director, Agriculture Department, Patna
6	"	Secretary, Energy Department, Patna
7	"	Secretary, Forest and Environment, Patna
8	"	Engineer-in-Chief (South), Water Resources Department, Patna
9	"	Engineer-in-Chief (North), Water Resources Department, Patna
10	"	Engineer-in-Chief (Central), Water Resources Department, Patna
11	"	Sri Basawan Sinha, Rtd Engineer-in-Chief, WRD, Patna
12	"	Director, WALMI, Patna
13	Convener	Member Secretary, Second Bihar State Irrigation Commission, Patna

Sub-committee 2 (For TOR 2,4 and 6)

1	Chairman	Member, Water Resources Development
2	Member	Engineer-in-Chief (South), Water Resources Department, Patna
3	"	Chief Engineer, Master Planning, Water Resources Department, Patna
4	"	Chief Engineer, Planning and Monitoring, WRD, Patna
5	"	Chief Engineer, Minor Irrigation, Patna
6	"	Sri P C N Shahi, Chief Engineer, WRD, Patna
7	"	Director, CWRS, Patna
8	"	Director, Hydrology Cell, Patna
9	"	Director, Ground Water Organisation, Patna
10	"	Director, Mines and Geology, Patna
11	"	Director, WALMI, Patna
12	"	Sri M N Singh, Geologist, Bihar State Planning Board, Patna
13	Convener	Member Secretary, Second Bihar State Irrigation Commission, Patna

Sub-committee 3 (For TOR 5 and 7)

1	Chairman	Secretary, Water Resources Department, Patna
2	Member	Secretary, Finance Department, Bihar, Patna
3	"	Secretary, Law Department, Bihar, Patna
4	"	Secretary, Minor Irrigation, Bihar, Patna
5	"	Engineer-in-Chief (South), WRD, Bihar, Patna
6	"	Engineer-in-Chief (North), WRD, Bihar, Patna
7	"	Sri Ram Bachan Sharma, Engineer-in-Chief (Rtd), WRD, Patna
8	"	Chief Engineer,Minor Irrigation, Bihar, Patna
9	"	Director, Revenue, WRD, Bihar, Patna
10	Convener	Member Secretary, Second Bihar State Irrigation Commission, Patna

Sub-committee 4 (For TOR 8 and 9)

1	Chairman	Member, Flood Management
2	Member	Secretary, Forest and Environment, Bihar, Patna
3	"	Chairman, Ganga Flood Control Commission, Patna
4	"	Sri Jitendra Bahadur, Ex Chairman, GFCC, Patna
5	"	Engineer-in-Chief (North), WRD, Bihar, Patna
6	"	Chief Engineer, Master Planning and Design, WRD, Patna
7	"	Chief Engineer, Central Design Organisation, WRD, Patna
8	"	Chief Engineer, Birpur (Kosi Project) WRD, Patna
9	"	Director, Soil Conservation, Patna
10	"	Director, IRI, Khagaul, Patna
11	Convener	Member Secretary, Second Bihar State Irrigation Commission, Patna

Sub-committee 5 (For TOR 10 and 11)

1	Chairman	Member, Economist
2	Member	Finance Department, Bihar, Patna
3	"	Secretary, Water Resources Department, Bihar, Patna
4	"	Secretary, Law Department, Bihar, patna
5	"	Engineer-in-Chief (North), WRD, Bihar, Patna
6	"	Engineer-in-Chief (South), WRD, Bihar, patna
7	"	Director, Revenue, WRD, Bihar, Patna
8	"	Director, A N Sinha Institute of Social Science, Patna
9	Convener	Member Secretary, Second Bihar State Irrigation Commission

Working Group for Sub-committee 1

1	Convener	Superintending Engineer, Second Bihar State Irrigation Commission
2	Member	Sri S C Sinha, Superintending Engineer, Monitoring Circle-1, Patna
3	"	Sri Shambhu Nath, Deputy Secretary, WRD, Patna
4	"	Sri Nagendra Prasad Singh, Ex-MLA
5	"	Sri Badri Singh, Ex-MLA

Working Group for Sub-committee 4

1	Convener	Sri R R P Sharma, SE, Flood Control Design Circle, Patna
2	Member	Sri B P Singh, Director, GFCC, Patna
3	"	Sri Devashish Chaudhary, Dy Director, Forest & Environment, Bihar
4	"	Sri A K Sinha, Director, Hydrology Cell, WRD, Patna

Working Group for Sub-committee 5

1	Convener	Sri S S Khan, EE, WRD, Patna
2	Member	Dr T Prasad, Director, CWRS, BCE, Patna
3.	"	Director, Revenues, WRD, Patna
4.	"	Sri I N Sharma, ANS Institute of Social Science, Patna

Teams of field officers for preparation of Outline of plan for development and management of water resources in Four Major River Basins namely Kosi, Gandak, Sone and Subernrekha vide Water Resource Department letter No. 3190 dated 28.9.92.

The Team constituted were as follows:-

1	Kosi River Basin		Sri P C N Shahi, Chief Engineer Samastipur.	Team Leader
			Sri Hira Lal Agrawal, Chief Engineer, Purnea	Member
			Sri Ram Chandra Shahi, Chief Engineer, Birpur	Member
2	Gandak River Basin	1	Sri K P Sinha, Chief Engineer, Siwan	Team Leader
		2	Sri S N Ram, Chief Engineer, Muzaffarpur	Member
		3	Sri K P Sinha, Chief Engineer, Motihari	Member
3	Sone River Basin	1	Sri K D Narayan, Chief Engineer, Aurangabad	Team Leader
		2	Other Members to be decided by the Team Leader	
4	Subernrekha River Basin	1	Sri K L Choudhry Chief Engineer, Ranchi	Team Leader
		2	Other Members to be decided by the Team Leader.	

LIST OF H'BLE MPs, MLAs, MLCs, Rtd ENGINEERS, MUKHIAS, SARPANCHS AND SOCIAL WORKERS WHOSE REPLIES HAS BEEN RECEIVED AGAINST THE QUESTIONNAIRE FOR DIFFERENT TORs OF SECOND BIHAR STATE IRRIGATION COMMISSION

MP

1 Sri Rameshwar Thakur, State Minister of Finance, GOI

2 Sri Nitish Kumar, MP

MLAs and MLCs

1 Sri Tulsi Das Mehta, Minister,Energy Department,Bihar, Patna

2 Sri Hari Narayan Singh, Minister of State, Agriculture, Bihar

3 Sri Rajo Singh, MLA

4 Sri Sivadani Prasad Singh, MLA

5 Sri Amrendra Mishra, MLA

6 Sri Ran Vijay Sahi, MLA

7 Sri Ramdeni Ram, MLC

Retired Engineers

1 Sri K N Lal, Engineer-in-Chief, WRD, Patna

2 Sri P L Srivastava, Chief Engineer, WRD, Patna

3 Sri A Kumar, Chief Engineer, WRD, Patna

Pramukh/Mukhia/Social Worker

1 Sri Rajedra Prasad Sharma, General Secretary, Bihar Rajya Panchayat Parishad, Patna

2 Sri Shyam Sunder Sah, Mukhia, Gram Panchayat, Nisi

3 Sri Kailash Pandey, Mukhia, Gram Panchayat & Block, Barh, Patna

4 Sri Nawal Kishore Sharan Singh, Mukhia, Gram Panchayat, Telmar, Nalanda

5 Sri Yadunandan Prasad Singh, Mukhia, Grampanchayat, Samayagarh, Patna

6 Sri Surendra Prasad Sinha, Mukhia, Gram Panchayat, Murtajapur, Barh Block, Patna

7 Sri Paramhans Narayan Singh, Pramukh, Punpun Block, Patna

8 Sri Raj Kishore Prasad, Pramukh, Dhanarua Block, Patna

9 Sri Ram Chandra Prasad, Social Worker, Janta Dal

LIST SHOWING NAMES OF C D BLOCKS FROM WHICH LIST OF PROBABLE IRRIGATION SCHEMES WERE RECEIVED

Sl.No.	Name of Districts	Name of blocks
1	East Champaran	Chiraiya, Mahesi, Turkaulia, Areraj, Harsidih, Chakia, Pakri Dayal, Motihari, Kalyanpur, Raxaul
2	West Champaran	Narkatiaganj, Bagha, Mainatand, Ramnagar, Bagha 2, Gonha, Chanpatia
3	Saran	Dariapur, Sonepur, Ekma, Jalalpur, Madhaura, Manjhi, Baniapur, Dighwara
4	Siwan	Pachrukhi, Siswan, Maharajganj, Daraundha, Darauni, Goriakothi, Guthauni
5	Gopalganj	Gopalganj
6	Gaya	Fatehpur, Bodhgaya, Mohanpur, Belaganj
7	Patna	Pandarak, Itkhori, Paliganj, Patna Sadar, Masaurhi, Danapur, Bikram, Phulwarisharif, Dhanarua
8	Jamui	Jhajha, Jamui, Sikandara
9	Nalanda	Rajgir, Asthawan, Noorsarai
10	Munger	Surayagarha, Munger Sadar
11	Nawada	Gobindpur, Hisua, Warsliganj, Akbarpur, Narhat, Sirdala, Pakribarawan
12	Palamu	Hariharganj, Lesliganj, Mahuatand, Garhwa, Manika
13	Aurangabad	Obra, Haspura, Deo, Madanpur, Rafiganj
14	Bhagalpur	Sultanganj, Nathnagar, Jagdishpur
15	Sahebganj	Sahebganj, Hiranpur
16	W Singhbhum	Kuchai, Sonua, Jagannathpur, Bandgaon, Saraikela
17	Samastipur	Mohiuddinnagar, Hasanpur, Dalsinghsarai
18	Vaishali	Vaishali, Hazipur, Mahnar
19	Begusarai	Khodabandpur, Begusarai, Sahebpurkamal, Bhagwanpur
20	Muzaffarpur	Motipur
21	E Singhbhum	Chakulia, Bahragora

Sl.No.	Name of Districts	Name of blocks
22	Dhanbad	Baliapur
23	Hazaribagh	Jainagar, Itakhori, Barkatha, Ichak, Churchu, Keraderi, Gola
24	Giridih	Jamua
25	Bokaro	Chas, Tundi
26	Ranchi	Rania, Mandar
27	Lohardagga	Ghaghra
28	Gumla	Kamdara, Bolba, Jaldega, Thethainagar, Simdega, Bishunpur, Dumri
29	Dumka	Jarmundi, Jamtara
30	Banka	Baunsi
31	Godda	Mahgama
32	Bhojpur	Itari, Simri, Rajpur, Chatpokhri, Sahar
33	Bhabhua	Durgawati, Mohania, Adhaura
34	Kishanganj	Bahadurganj, Kishanganj
35	Katihar	Pranpur
36	Araria	Jokihat
37	Purnia	Kasba, Baisi, Banmankhi
38	Saharsa	Sonbarsa
39	Supaul	Triveni
40	Madhepura	Singheshwar, Kumartand
41	Darbhanga	Ghanshyampur, Manigachi, Hayaghat
42	Madhubani	Andhrathari, Bisfi, Basopatti, Pandaul, Madhwapur
43	Sitamarhi	Pupri

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ERRATA

Page	Line	Being read as	To be read as
iii	10	सिंचाई आयोग का निर्णय	सिंचाई आयोग के गठन का निर्णय
	32	नमूने के अधिनियम का प्रारूप भेजा है।	आदर्श सिंचाई संहिता का प्रारूप अनुमोदनार्थ भेजा है।
iv	19	पूरा सहयोग दिए हैं।	पूरा सहयोग दिया है।
ix	9	Command Area Development Authority	Command Area Development Agency
x	20	Indian Meteorological Department	India Meteorological Department
xiii	18	Water Meteorological Organisation	World Meteorological Organisation
5	12	letter no 1/PMC/N/60/86-268	letter no 1/PMC/M/60/86-268
8	30	Supering tending Engineer	Superintending Engineer
12	33	also the Commission	also left the Commission
18	15	20.641 11.91	20.641 11.91
		173.306 100	173.306 100
20	9	51824.00	51983.70
	13	3250.00	3249.40
	23	2254.00	2253.50
	38	4182.30	4183.60
21	22	279.3	426.0
	23	2806.8	2660.0
	26	10756.1	10755.0
	33	Siuth	South
	36	Subernrekha	Subernarekha
	40	33645.6	33644.6
35	3	1663.0	1963.0
37	Table 17	Culturable area Cropping intensity	Culturable area (ha) Cropping intensity (%)
41	31	21.05	22.05
42	4	5.293	5.333
	4	4.157	4.367
43	13	25.09	68.49
47	Last line	16.67	17.00
63	35	has to taken up	has to be taken up
64	6	should declared and bridge	should be cleared and bridges
67	29	them in their designed	them to their designed
76	26	laid not only	led not only
88	19	five year	five years
	Add at the end of para 177		[Regarding this recommendation, Sri Saryu Rai, Member, had different view which is recorded in Volume VI]
89	28	which earning	which is earning
	30	derived bt	derived by
90	13	bonafied	bonafide
91	29	(State Officer)	(Estate Officer)
	30	(all typist)	(all typists)
	31	Sri Brinder Kumar Sinha	Sri Bijendra Kumar Sinha
	33	Commision	Commission
94	2	STORAGE, STORAGE	STORAGE. STORAGE
98	17	TO IRRIGATED SMALL	TO IRRIGATE SMALL
99	1	TO RETAIN SOLD	TO RETAIN SOILS
101	11	on the lines of South Bihar	on the above lines in South Bihar
103	6	AFORESTATION	AFFORESTATION
104	3	EDUCATION	EDUCATING