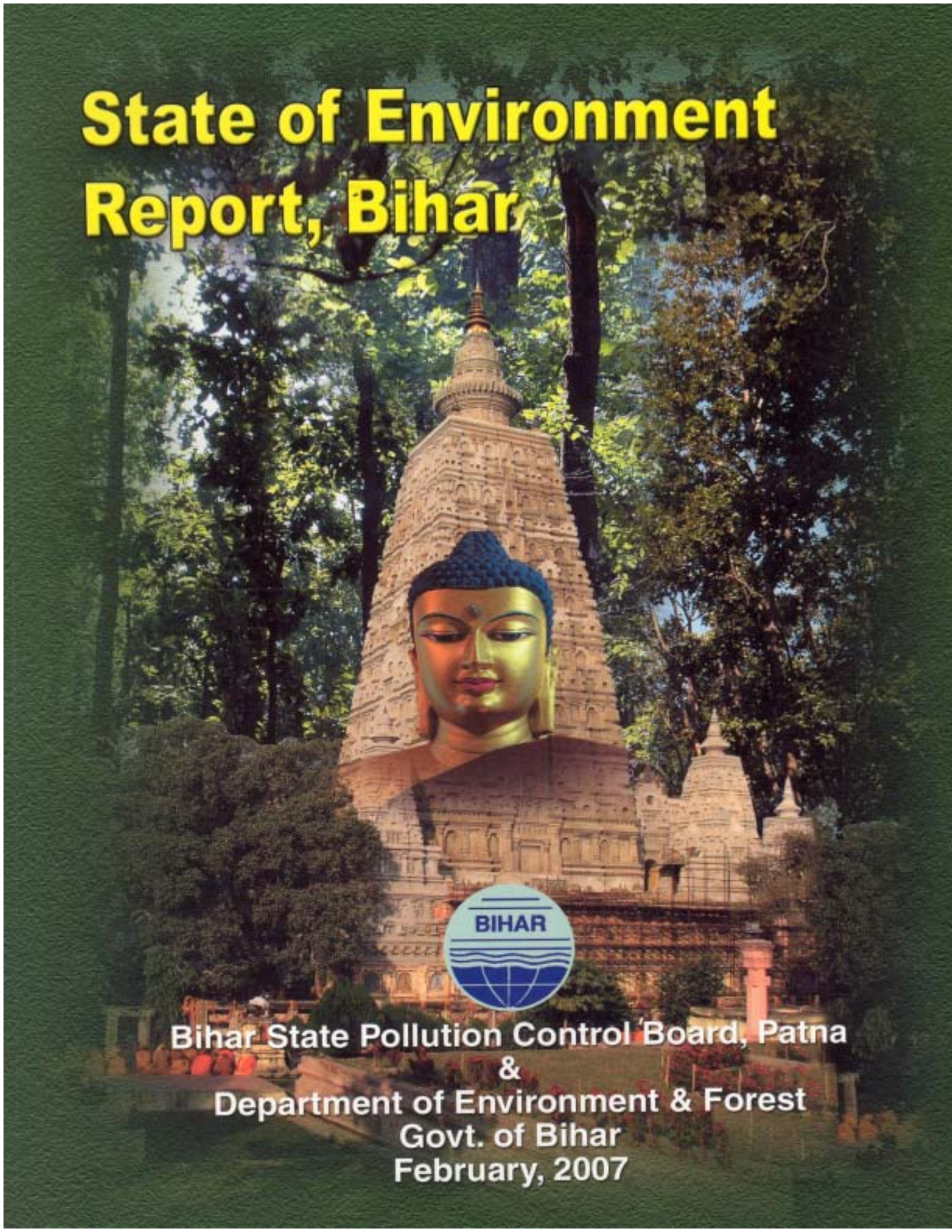
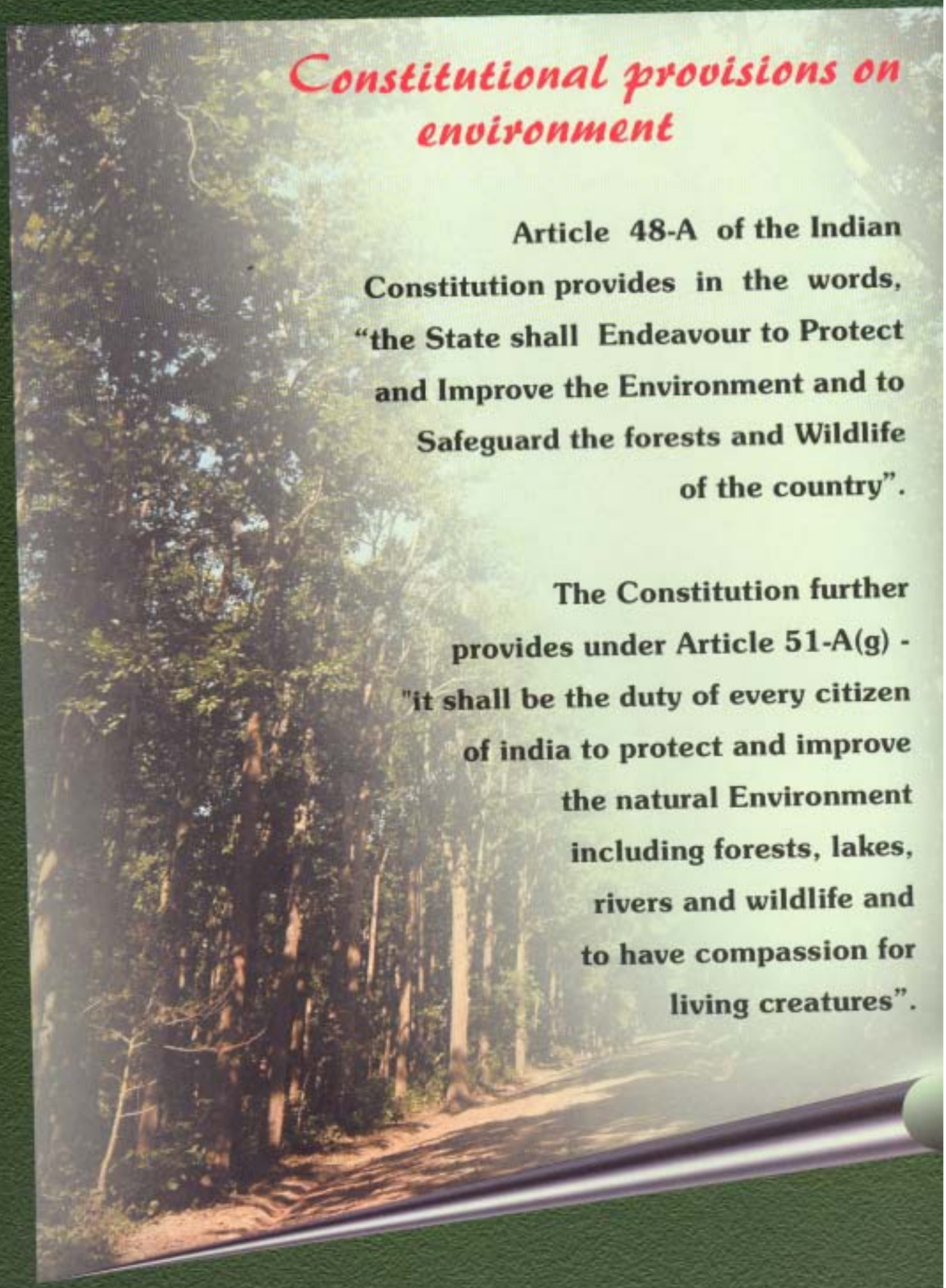
State of Environment Report, Bihar



Bihar State Pollution Control Board, Patna
&
Department of Environment & Forest
Govt. of Bihar
February, 2007



Constitutional provisions on environment

Article 48-A of the Indian Constitution provides in the words, "the State shall Endeavour to Protect and Improve the Environment and to Safeguard the forests and Wildlife of the country".

The Constitution further provides under Article 51-A(g) - "it shall be the duty of every citizen of india to protect and improve the natural Environment including forests, lakes, rivers and wildlife and to have compassion for living creatures".

State of Environment Report, Bihar

Bihar State Pollution Control Board, Patna
&
Department of Environment & Forest
Govt. of Bihar

मुख्य मंत्री
बिहार

बिहार सरकार

पटना

सन्देश

मुझे प्रसन्नता है कि बिहार राज्य प्रदूषण नियंत्रण पर्षद् तथा पर्यावरण एवं वन विभाग, बिहार सरकार द्वारा संयुक्त रूप से राज्य का पर्यावरणीय स्थिति प्रतिवेदन तैयार किया गया है ।

यह प्रतिवेदन राज्य की पर्यावरणीय समस्याओं एवं प्रदूषण के दुष्परिणामों से परिचय कराता है । इस प्रतिवेदन में पर्यावरण से जुड़े विभिन्न पहलुओं, यथा-जल, वायु, भूमि आदि से संबंधित आँकड़ों का संकलन किया गया है तथा विकास के विभिन्न क्रियाकलापों द्वारा पर्यावरण के अवयवों पर पड़ने वाले दबाव का आकलन एवं इसके कुप्रभाव के निवारण हेतु कतिपय उपाय भी सुझाये गये हैं । राज्य में पहली बार प्रकाशित इस प्रतिवेदन से राज्य के नागरिकों, बुद्धिजीवियों, राजनीतिज्ञों, नीति-निर्धारकों एवं पर्यावरण विशेषज्ञों को राज्य की पर्यावरणीय स्थिति की सही जानकारी प्राप्त हो सकेगी ।

ऐसे तथ्यपूर्ण प्रतिवेदन का प्रकाशन वर्त्तमान में एक सराहनीय कदम है । आशा है, यह प्रतिवेदन राज्य की पर्यावरणीय स्थिति के संरक्षण एवं संवर्द्धन हेतु एक उपयोगी दस्तावेज साबित होगा ।

(नीतीश कुमार)

सुशील कुमार मोदी,
उप मुख्य मंत्री,
बिहार ।

बिहार सरकार

पटना

पत्रांक 573 दिनांक – 09.03.07

संदेश

मुझे यह जानकर हार्दिक प्रसन्नता हुयी कि "बिहार राज्य प्रदूषण नियंत्राण पर्षद्" तथा "पर्यावरण एवं वन विभाग, बिहार" द्वारा राज्य का "पर्यावरण स्थिति प्रतिवेदन" तैयार किया गया है । इस प्रतिवेदन में पर्यावरण के विभिन्न घटकों पर पड़ने वाले दबाव का आकलन करने का प्रयास किया गया है । आर्थिक एवं सामाजिक विकास के साथ-साथ पर्यावरण का संरक्षण एवं इसके विभिन्न घटकों के बीच पर्यावरणीय संतुलन बनाये रखना युग चेतना का विषय है । आशा है यह प्रतिवेदन अपने राज्य के संदर्भ में इस उद्देश्य की पूर्ति मे सहायक सिद्ध होगा । यह नीति-निर्धारकों, बुद्धिजीवियों, पर्यावरणविदों एवं आम जनता के लिए लाभकारी होगा ।

इस प्रतिवेदन का प्रकाशन एक प्रशंसनीय कदम है । प्रतिवेदन की सार्थक सफलता की कामना करता हूँ ।

(सुशील कुमार मोदी)

रामचन्द्र सहनी,
राज्यमंत्री (स्वतंत्र प्रभार)
पर्यावरण एवं वन विभाग,
बिहार सरकार

बिहार सरकार

आवास सं० - 17
हार्डिंग रोड, पटना ।
दूरभाष : 2223236 (का०)
2221534 (आ०)
06252-240127 (मोतिहारी)

दिनांक - 10.03.07

संदेश

जनसंख्या में अनवरत वृद्धि, मनुष्य की उपभोक्तावादी सुखों की लिप्सा एवं पर्यावरण से अनावश्यक छेड़-छाड़ के कारण प्रदूषण ने विकराल रूप धारण किया है । आर्थिक एवं सामाजिक विकास के साथ-साथ पर्यावरण का संरक्षण एवं इसके विभिन्न घटकों के बीच परिस्थितिकी संतुलन बनाये रखना इस युग की पुकार है ।

मुझे यह जानकर हार्दिक प्रसन्नता है कि पर्यावरण एवं वन विभाग, बिहार सरकार तथा बिहार राज्य प्रदूषण नियंत्राण पर्षद् ने भारत सरकार द्वारा संपोषित एक परियोजना के अन्तर्गत बिहार राज्य की वर्त्तमान पर्यावरणीय स्थिति से संबंधित एक प्रतिवेदन तैयार किया है । आशा है कि यह प्रतिवेदन पर्यावरण संरक्षण से जुड़े सभी क्षेत्र के लोगों एवं आम नागरिकों के लिए एक महत्वपूर्ण दस्तावेज साबित होगा ।

शुभकामनाओं सहित।

10.03.07

(रामचन्द्र सहनी)
राज्य मंत्री (स्वतंत्र प्रभार)
पर्यावरण एवं वन विभाग

शिशिर सिन्हा, भा०प्र०से०
सचिव

पर्यावरण एवं वन विभाग,
बिहार सरकार

संदेश

बिहार राज्य के पर्यावरण की स्थिति का पहला प्रतिवेदन पर्यावरण एवं वन विभाग तथा बिहार राज्य प्रदूषण नियंत्रण पर्षद् द्वारा तैयार किया गया है । यह प्रतिवेदन प्रत्येक तीन वर्षों में तैयार किया जाना प्रस्तावित है ।

इस प्रतिवेदन में मानव की गतिविधियों के कारण पर्यावरण पर पड़ने वाले प्रभाव की स्थिति दर्शाते हुए निदान हेतु किये जाने वाले प्रयासों की चर्चा की गई है ।

बिहार राज्य प्रदूषण नियंत्रण पर्षद् द्वारा इस प्रतिवेदन हेतु आँकड़ों का संकलन एवं इसका प्रकाशन एक प्रशंसनीय कदम है । मुझे विश्वास है कि आँकड़ों एवं अनुभवों के आधार पर तैयार किया गया यह प्रतिवेदन राज्य के पर्यावरण संरक्षण हेतु नीति-निर्धारकों एवं जागरूक नागरिकों के लिए एक महत्वपूर्ण अभिलेख सिद्ध होगा ।

(शिशिर सिन्हा)
सरकार के सचिव,
पर्यावरण एवं वन विभाग,
बिहार सरकार, पटना।

FOREWORD

The term 'Environment and Ecology' includes water, air, land and the inter relationship which exists among and between all these physical and biological factors like human beings, other living creatures, plants and micro-organisms. For proper understanding of the environment, information related to all its components is required. Our country is passing through a phase of rapid industrialization and development which is causing great pressure on our environment. Our Mother Earth is facing threats due to over exploitation of our natural resources, increasing ecologically degraded areas and risk from pollution. There is an urgent need for proper monitoring and management of the environment and to achieve the goal of sustainable development. Information about all of the factors and components of the environment is vital for any decision making process for effective environmental management. The sound data base is very much required for policy decisions, proper planning and implementation of developmental projects.

To achieve the goal of sustainable development and to provide an overview of the prevailing bio-physical and socio-economic conditions of a state, Ministry of Environment and Forests, Government of India launched a scheme during the 10th Five Year Plan for assisting the state governments to bring out a State of Environment (SoE) Reports for their State on triennial basis. These reports are aimed at giving an opportunity to assess how human activities affect the environmental conditions and implications of human health and economic well being. These reports will create a mechanism for the integration of environmental, social and economic information with the goal of providing the clear picture of the condition of the State and may prove an early warning of the potential problems as well as allowing for the evaluation of all possible scenarios for the future.

Ministry of Environment and Forests, Government of India have designated, 'Development Alternatives', New Delhi as National Host Institute (NHI) to successfully bring out on SoER for Bihar. Department of Environment and Forest, Government of Bihar has been identified as State Nodal Agency and this Board was given the responsibility of 'State Host Institute' (SHI). This Board had conducted various meetings, workshops etc. with concerned departments and other stake holders for bringing out this report. I believe that this report will fulfill its objective to provide the public, government, non-governmental organizations and decision makers with accurate, timely and accessible information on the state of current environment and future outlook for our State's Environment.

The present (SoE) report-process comprise of two parallel flow routes coming together at a critical juncture. One branch focuses on perception based participatory approach and the other system adopts a data based approach. The data based route for Environmental Appraisal Studies (EAS) comprises of (A) State of parameters e.g. Geoenvironmental, Non-Geoenvironmental and Biotic (B) Pressure- generated over them, in terms of Environmental Resources e.g. Brown Agenda, Green Agenda and Blue Agenda; and (C) Driving Force-identified as Geogenic and Anthropogenic activities.

The perception based approach helped in the formulation of (A) Environmental Impact Assessment (EIA), where the interaction between the defined environmental issues and impact factors are evaluated and prioritized within the framework of social and economic aspect. Further, the Environmental Management Plan (EMP) entails the information about the measures to be adopted by the different stake holders to improve the situation.

The cut-off score for environmental hotspots is taken in any four of the seven environmental problems viz. (i) Disaster; (ii) Land degradation; (iii) Bio-diversity; (iv) Water imbalance; (v) Un-organized urbanization; (vi) Industrialization; and (vii) Awareness.

As per the analysis, seven issues crossed the criteria in Begusarai district; six issues in seven districts; five issues in sixteen districts and four issues in the remaining all the districts. To be able to remediate the environmental problems, a prioritization of the problems has been worked out, which needs a careful cost effective analysis of the situation.

The arduous task of preparing this Report could be possible only with the efforts of all my colleagues specially Sri S. Narayana Rao, Member-Secretary, Dr. Naveen Kumar, Assistant Scientific Officer and Sri. B. N. Singh, Senior Law Officer of the Board, which is duly acknowledged. I am also thankful to the Ministry of Environment and Forests, Government of India for providing financial support and to the State Nodal Agency, the National Host Institute and other line departments, agencies of the central and state government for extending their cooperation and providing us with the relevant data and other related information to bring out this report.

Chairman
BSPCB, Patna.

S.N. Rao
Member-Secretary

Bihar State Pollution Control Board,
BELTRON Bhawan, 2nd Floor,
Shastri Nagar, Patna - 800 023.

Acknowledgement

Environmental Stake Holders including Policy and Decision makers need to have access to a constant, reliable and comparable data on the natural and environmental resource base for its effective management and sustainable development. The present State of Environment Report (SoER), Bihar not only would serve in providing reliable data but also form a base line for such reports in future.

I would like to express our sincere thanks and gratitude to Ministry of Environment & Forests, Government of India for undertaking a nationwide programme in preparing the State of Environment Reports for all the States of the country and providing financial support for the purpose.

Thanks are also due to Development Alternatives, New Delhi, the National Host Institution, identified for this State for their active association in preparation of this report. I would also thank Department of Environment & Forest, Government of Bihar for their kind support in bringing out this report as State Nodal Agency.

We record our sincere thanks to Geological Survey of India, Eastern Region, Kolkata for preparation of this report and also providing data on geology.

The information and data provided by various line departments of State like Water Resources; PHED; Transport; Agriculture; Industries; Soil Conservation; Mines and Geology; Revenue and Land Reforms; Urban Development; Health and Family Welfare; Bihar State Electricity Board and other agencies are also duly acknowledged. This report could not have been prepared without their valued support. My special thanks are due to the Chairman, Bihar State Pollution Control Board for his active support by his time to time guidance without which publication of this report could not have been possible. I shall be failing in my duty, if I do not extend my sincere thanks to all my colleagues in Bihar State Pollution Control Board, who provided constant support and co-operation through out the period of its preparation.

Last but not the least, there is always some scope for improvement and for the same reason comments, suggestions, if any, of all the stake holders are solicited, which will help us bring out next report in a more comprehensive manner.

(S. N. Rao)
Member-Secretary.

CONTENTS

List of Plates :

INTRODUCTION

1.1 Background

In pursuance of the Ministry of Environment and Forests, Government of India decision to introduce a scheme during the 10th five year plan for assisting the State Governments to bring about the 'State of Environment (SoE) Report for representative states on triennial basis, the state of Bihar has also to prepare the said report, which will provide an overview of the prevailing bio-physical and socio economic conditions of the state.

For successfully brining out this report, Ministry of Environment and Forests, Government of India has designated Development Alternatives, New Delhi as National Host Institute for the State of Bihar. Department of Environment and Forest, Government of Bihar has been designated as 'State Nodal Agency' whereas, Bihar State Pollution Control Board has been designated as 'State Host Institute' for the purpose. A series of meetings for the purpose were organized represented by different Government Organizations, Stake Holders and NGOs. In the deliberations several environmental issues were unanimously conceived, which were finally categorized into 6 classes to be addressed and evaluated under the existing conditions. The 6 categories, so classified are:

(i) Disaster

(ii) Land Degradation

(iii) Bio-Diversity

(iv) Water Imbalance

(v) Industrialization, and

(vi) Awareness.

Bihar State Pollution Control Board as the 'State Host Institute' (SHI) solicited Geological Survey of India for the preparation of geo-environmental data.

1.2 Objective of the Scheme

The objectives of the scheme, as envisaged by the Government of India, behind preparing the State of Environment Report are:

- To provide the public, government, non-government organizations and decision makers with accurate, timely and accessible information on the state of current environment and future outlook for a region's environment;

- To report on the effectiveness of the policies and programmes that have been designed to respond to environmental changes, including progress towards achieving environmental standards and targets;
- To create a mechanism for the integration of environmental, social and economic information with the goal of providing a clear picture of the condition of the states;
- To provide early warning of the potential problems as well as allowing for the evaluation of possible scenario for the future;
- To assess the nation's progress towards achieving ecological sustainability;
- To identify gaps in the state of nation's knowledge of environmental conditions and trends and recommend strategies for research and monitoring to fill these gaps; and
- To help making judgment regarding the broad environmental consequences of social, economic and environmental policies and plans.

1.3. METHODOLOGY :

The methodology adopted in SoE reporting process envisages two parallel flow route of the reporting system coming together at critical junctures. One branch of the system focuses on perception based participatory approach and the other system adopts a data based approach (Fig. 1). Thus the system conjugates both participatory and analytical angle to ensure scientific robustness coupled with awareness and ownership building among stakeholders.

The SoE reporting is carried out in three compartments :-

(i) Environmental Appraisal Studies (EAS)

EAS describes the status and cause effect relationship of the given environmental issues.

(ii) Environmental Impact Assessment (EIA) and

EIA forecasts and assess the impact on environment.

(iii) Environmental Management Plan (EMP)

EMP describes the response strategies and mitigation measures for protection of environment.

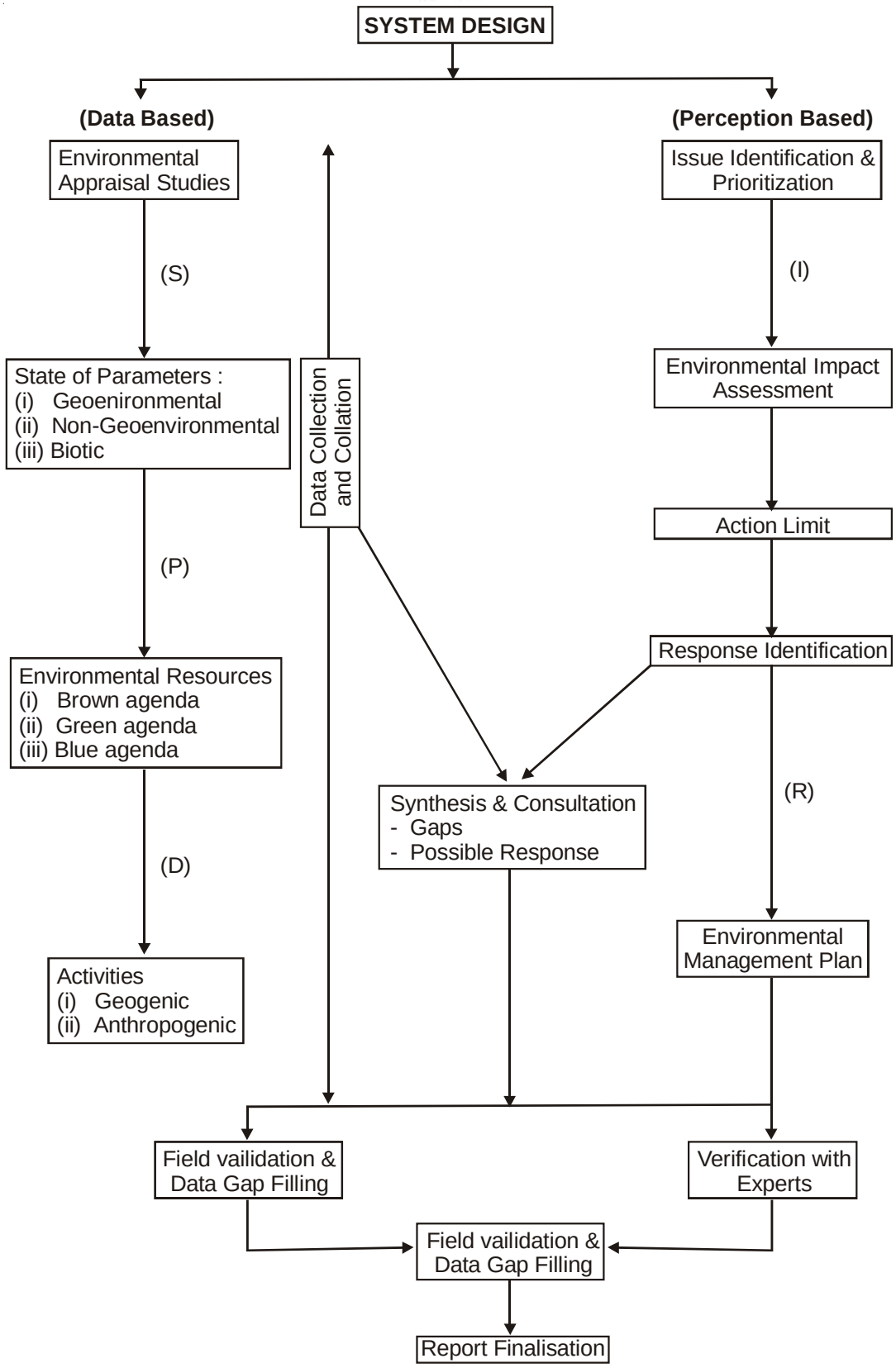

SYSTEM DESIGN
(Data Based)
(Perception Based)
Environmental Appraisal Studies
Issue Identification & Prioritization
(S)
(I)
State of Parameters :
(i) Geoenironmental
(ii) Non-Geoenvironmental
(iii) Biotic
Data Collection and Collation
Environmental Impact Assessment
Action Limit
(P)
Response Identification
Environmental Resources
(i) Brown agenda
(ii) Green agenda
(iii) Blue agenda
Synthesis & Consultation
- Gaps
- Possible Response
(R)
(D)
Environmental Management Plan
Activities
(i) Geogenic
(ii) Anthropogenic
Field vailidation & Data Gap Filling
Verification with Experts
Field vailidation & Data Gap Filling
Report Finalisation

Fig.1

Under EAS the database on the state(s) of six nos. of geoenvironmental parameters, three nos. of non-geoenvironmental parameters and two nos. of biotic parameters are addressed (Fig. 2).

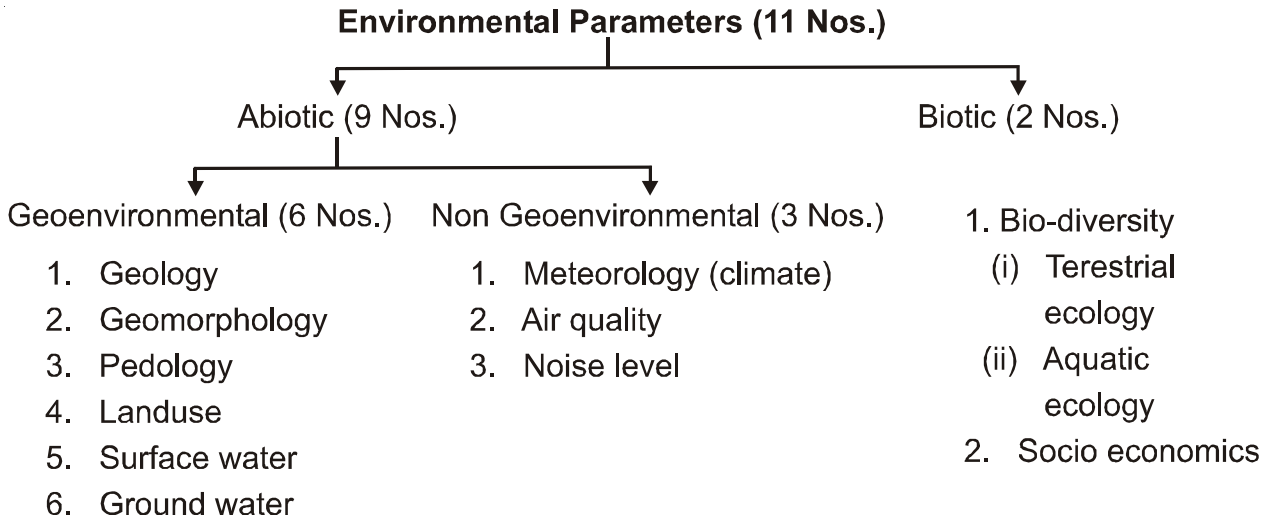


Fig. 2

This database forms the S-part of DPSIR (Driving force-Pressure-State-Impact-Response) framework of evaluation. It is followed by the documentation of Environmental Resources and pressure generated over them i.e., P-part of DPSIR. Further, the activities categorised under Geogenic and Anthropogenic are elaborated with the aim to establish the causative linkage as Driving Force i.e., D-Part of the DPSIR framework. The interaction between the defined activities and ambient environmental parameters within the backdrop of social and economic aspect are summarised under the schedule of Environmental Impact Assessment (EIA). This exercise generates the database for I-Part of DPSIR framework. Finally, the Environmental Management Plan (EMP) entails the information about the measures to be adopted by the different stakeholders to improve the situation i.e., R-part of the DPSIR frame work.

1.4. SCOPE :

The scope of the State of Environment (SoE) document is to provide an accurate assessment of (1) the State of Environment and (2) the consequences of policies on the environment, which is supposed to be critical for effective further decision-making. In order

to fulfill this need, it has been decided to bring out such document on triennial basis for the State of Bihar. The preparation of database, their synthesis and consultation with stakeholders leading to assessment of policies and emerging issues would be integrated for their ground applicability within the frame work of sustainable development decision-making cycle.

Further, the ground evaluation of the environmental trends and conditions of the community will have to be assessed the relative importance of different environmental issues and set priorities.

1.5 ACKNOWLEDGEMENT :

The Present publication is the outcome of the joint effort by Bihar State Pollution Control Board (BSPCB), Patna with the Geological survey of India, Ministry of Mines, Go I for the preparation of "State of Environment (SoE) Report" for Bihar. The database for this report comprises of geoenvironmental, non-geoenvironmental and biotic parameters. The geoenvironmental database is based on published reports of GSI and C.G.W.B. the non-geoenvironmental database was provided by Bihar state Pollution control Board, Indian Meteorology Dept. central water commission, GOI Water Resources department. GOB, Directorate of Industries; GoB, P.H.E.D, GoB, state Transport Dept., GoB, Directorate of soil conservation; GoB, Bihar state Electricity Board, Patna, Department of mines and geology, GoB and various other central and state govt. depts. While preparation of this report the valuable suggestions made and the supporting database as provided by them are thankfully acknowledged.

Further, the participating representatives from the water Resources Dept.; GoB, Health Dept; GoB. Directorate of Survey; GoB, Directorate of Agriculture, GoB, Dept. of Revenue and Land Reforms, GoB, S.F. Env. S & P.E. Directorate, Urban Development Dept; GoB deserve special thanks for taking keen interest by way of attending meeting on 18-3-2006 and discussing the subject matter, at length, of this report. The support given by Ministry of Environment and Forests, Government of India and Development Alternatives, the National Host Institute is also duly acknowledged.

BIHAR : OVERVIEW

Bihar is located in the eastern part of the country. It is an entirely land locked state, although the outlet to the Sea through the port of Kolkata is not far away. Bihar lies midway between the humid West Bengal, in the east and the sub humid Uttar Pradesh, in the west which provides it with a transitional position in respect of climate and economic activities. It is bounded by Nepal in the north, Jharkhand in the South. The Bihar plain is divided into two unequal halves by the river Ganga which flows through the middle from west to east. The physical divisions based on bio-physical and historical antecedence are depicted in Plate No. 1. The state of Bihar has always been in the centrestage of the country's economic, cultural, historical and political activities. It has acquired a new identity on 15th November 2000 after the creation of the State of Jharkhand out of it. It occupies a total geographical area of 94,163 sq. km and is extended for 483 km from east to west and 345 km from north to south. The physical feautures of the State and its administrative units are presented in table 1.

The map showing the location of various districts of Bihar is depicted in Plate No. 2

POPULATION DYNAMICS :

The State of Bihar, with an area of 94,163 sq. km approximately, has a population of 8,28,78,796. Till 1991 census, the composite state of Bihar was the Second most populous state in the country, next only to Uttar Pradesh. However, after bifurcation of the state of Bihar and creation of the new state of Jharkhand, the position of Bihar among the states of India in respect of population has slipped down to third. Decaled growth of population, demographic indicators and related facts are presented from Table 2 to 4.

TABLE NO. 1

Physical Features

Latitude	-	24°-20'-30" & 27°-31'-15"N
Longitude	-	83°-19'-50" & 88°-17'-40"E
Rural Area	-	92,257.51 sq. km
Urban Area	-	1,095.49 sq. km
Total Area	-	94,163.00 sq. km
Height above sea level	-	52.73 m
Normal Rainfall	-	1,205 mm
Avg. No. of Rainy days	-	52.5 days in a year.

Administrative Units

Divisions	-	9
Districts	-	38
Sub-divisions	-	101
CD blocks	-	534
Panchayats	-	8,471
Number of Revenue Villages	-	45,103
Number of urban agglomerations	-	9
Number of Towns	-	130

TABLE - 2 : GROWTH OF POPULATION IN BIHAR/INDIA

	Population	Decadal variation in % (Bihar)	Decadal variation in % (India)
1901	27,311,865		
1911	28,314,281	+ 3.67	+ 5.75
1921	28,126,675	– 0.66	– 0.31
1931	31,347m108	+ 11.45	+ 11.00
1941	35,170,840	+ 12.20	+14.22
1951	38,782,721	+ 10.27	+ 13.31
1961	46,447,457	+ 19.76	+ 21.51
1971	56,353,369	+ 21.33	+ 24.80
1981	69,914,734	+ 24.06	+ 24.06
1991	89,374,465	+ 23.54	+ 23.85
2001	8,28,78,796 (Bihar)	+ 28.43	+21.34

TABLE - 3 : SOCIO - DEMOGRAPHIC INDICATORS OF THE NEW "BIHAR" STATE

Indicators	Bihar		India	
	'91	'01	'91	01
Percentage decadal growth rate	23.36	28.43	23.86	21.34
Sex ratio	907	921	927	933
Population Density (Population per sq. km)	685	880	267	324
Population '01	82,878,796		1,027,015,247	
Literacy rate (%) (+7 years Population)				
Male	60.32		75.82	
Female	33.57		54.16	
Total	47.53		65.38	

% of SC Population to the total population	15.5	16.20
% of ST Population to the total Population	0.8	8.10
% of cultivators/total main workers	41.0	34.10
% of Agricultural labour total main workers	43.1	37.46
Per Capita income (Rs)	2197	
Area (sq. km)	94,163	32,87,263

TABLE - 4

According to the census 2001, the state of Bihar has following facts on Population.

Population (2001 Census)	82998409
Males	43243795
Females	39754614
Sex ratio (females/1000 males)	921
Density of Population (persons/sq. km)	880
Urban Population %	10.47
Literacy rate (census 2001) in %	47
Male literacy in %	59.7
Male literacy in numbers	20644376
Female literacy in %	33.1
Female literacy in Numbers	10465201
Birth rate (per 1000) (2002) P	30.9
Death rate (per 1000)	7.9
NSDP at current prices Rs. in cr (2002-'03)	51345
Per Capita NSDP in Rs. (2002-'03)	6015

INDEX

(2002) P : Provisional
(2002-03) : Advanced estimates
(2001-02) : Quick Estimates
(2000-01) : Provisional Estimate
NSDP : Net State Domestic Product

ENVIRONMENTAL APPRAISAL STUDIES (EAS)

Environmental Appraisal Studies (EAS) have been carried out to decipher and document the overall environmental scenario of the State of Bihar. The overall environmental scenario is mainly controlled by three factors (i) Environmental resources (ii) Environmental constraints and (iii) Level of degradation (anthropogenic / geogenic). Depending on the relative predominance of these factors, the inherent strength or fragility of the environment is determined. This characterisation is important as it leads to the calculation of ”Bearing Capacity” of an environment, which in turn, dictates the level of developmental activities which can be taken up with minimum damage to the environment.

In general, EAS covers 11 Standard Environmental Parameters. These are shown in Fig. 2.

3.1 ENVIRONMENTAL PARAMETERS :

3.1.1.1. Geology :

Geologically, it represents the extreme northern front of Indian sub-continent. These include (i) the belt of Himalayan foothills in the northern fringe of Paschim Champaran (ii) the vast Ganga Plains, (iii) the Vindhyan (Kaimur) Plateau extending into Rohtas region, (iv) the sporadic and small Gondwana basin outliers in Banka district, (v) the Satpura Range extending into large part of the area North of Chotanagpur Plateau, (vi) the parts of Bihar Mica belt in Nawada, Jamui and Banka districts and (vii) the Granite Gneissic complex of Chotanagpur plateau. Nearly two third of Bihar is under cover of Ganga basin composed of alluvium and masks the nature of basement rocks. The geological map of Bihar is presented at Plate 3.

Table - 5 : Showing the Geological Succession and their geographic distribution

Increasing antiquity ↓

Age	Geology	Geography	Text Index
Quaternary	Alluvial deposits (Sand, Clay, Silt, fragments)	North Bihar Plain & Central Bihar Plain	2
Tertiary	Sandstones and Clay Stones	North Champaran Hills	1
Gondwana	Coal Measures, Forming a series of small outlier basins	Banka district	4

Increasing antiquity ↓

Age	Geology	Geography	Text Index
Vindhyans	Sandstones, Shales, Limestones etc.	Parts of Bhabhua and Rohtas dist.	3
Satpura	Schist, Phyllite, Quartzite	Part of Aurangabad, Gaya, Nawada, Nalanda, Sheikhpura and Munger Dist.	5
Proterozoic	Mica Schist, amphi-bolite, quartzite, granite, dolerite and pegmatite	Nawada, Jamui & Banka	6
Archaean	Gneisses, Granites, Schists, Phyllites, Quartzites, amphibolites & intrusives all metamorphosed sedimentary and igneous rocks	Parts of Aurangabad, Gaya, Nawada, Jamui, Banka and Bhagalpur	7

1. The Tertiaries are exposed in Masan area of North Champaran District, as a series of low hillocks. They represent Upper Siwaliks of the Sub-Himalayas and consist of sandstone and claystone, disturbed by folding and thrust faulting. The entire sequence here occurs as an inlier in the alluvial terrain.

2. The Quaternary of North Bihar Plains, between the tortuous course of Ganga and Himalayan foothills, are represented by Older Alluvium Group (OAG) (Bhangar) and Newer Alluvium Group (NAG) (Khader). The OAG is represented by Mirganj Formation, Khajauli Formation and Madhubani Formation in Gandak basin, Gandak-Kosi interfluve and Kosi basin, respectively. The NAG includes the Vaishali Formation, the Jainagar Formation and Purnea Formation in Gandak basin, Gandak-Kosi interfluve and Ganga-Kosi-Mahananda interfluve. In the whole region the uppermost formation is the Present Flood Plains, Diara formation, Channel Bars and Sand Dunnes.

   In central Bihar Plains the OAG forming the highest terrace, in the Son-Ganga alluvial tract, and NAG forming younger terraces, as Older Flood Plains, are exposed all along the Alluvial Upland. The Present Flood Plain deposits are confined with the channels.

3. The Vindhyans, in Bihar, are exposed in Rohtas and Bhabhua districts as scarps and plateau. They comprises gritty to fine cemented sandstones, shales, flagstones, quartzites, sandy siltstones, limestone breccias and porcellanites, the shales often being pyritiferous.

4. The Gondwana rocks occur as sporadic outlier basins, in the parts of Banka district. The main rock types are sandstones, fine to coarse or gritty sandstone, ironstone, shales, Carbonaceous shales, coal seams and boulder beds. They are largely cemented, jointed, fractured, faulted and intruded by dykes and sills.

5. Along the northern fringe of the Chotanagpur Granite Gneiss Complex are low-grade supracrustals covering the Kharagpur hills, Rajgir hills and Gaya hills referred to as the Satpura Range, comprises schists, ferruginous phyllite, quartzite and phyllitic shales.

6. The Bihar Mica belt comprises a sequence of folded hornblende schists, amphibolite, mica-schist, quartzite and calc-silicates intruded by circular to oval shaped granitic plutons, dolerites, pegmatites and quartz veins. There are may old mines of mica in this belt.

7. The Archaeans are the oldest rock formation in the state. The most predominant rock type is mainly of gneisses and granitic rocks with lesser amount of schists, quartzites, basic intrusives and pegmatoides. They are exposed in Aurangabad, Gaya, Nawada, Jamui, Bhagalpur and Banka districts.

For the purpose of Geoenvironmental Appraisal Studies the rock types are characterised in terms of following elements :–

(a) Fragility :

⑦ < ③ < ⑤ < ④ < ⑥ < ① < ②

Increasing fragility

(b) Proneness to Mass - movement :

③ < ⑤ < ⑦ < ④ < ⑥ < ① < ②

Increasing Proneness to mass movement

(c) Engineering Suitability :

(i) Foundation material :

③ > ⑦ > ⑤ > ② > ⑥ > ④ > ①

Decreasing Suitability

(ii) Construction Material :

⑥ > ⑤ > ③ > ⑦ > ④ > ① > ②

Decreasing Suitability

(d) Quarriability / excavation

③ > ⑤ > ④ > ⑦ > ⑥ > ② > ①

Decreasing quarriability

(e) Subsidence on underground activities :

② > ① > ⑥ > ④ > ③ > ⑦ > ⑤

Decreasing proneness to subsidence

(f) Hydraulic Conductivity :

② > ① > ⑥ > ④ > ⑦ > ⑤ > ③

Decreasing Conductivity

(g) Presence of Neo-tectonic activities and response to seismic distur bance.

① > ⑤ > ④ > ② > ⑦ > ⑥ > ③

Decreasing Neo-tectonism and seismicity

(h) Aquifer hosting suitability :

② > ⑦ > ④ > ⑥ > ⑤ > ③ > ①

Decreasing aquifer hosting suitability

(i) Potential for residual soil :

⑦ > ⑥ > ④ > ① > ⑤ > ③

Decreasing potential for generating in-situ soil

(j) Potential to (i) transmit liquid pollutants / leachates and (ii) adsorb pollutants.

① > ② > ④ > ⑤ > ⑥ > ⑦ > ③

Decreasing order of transmitting liquid pollutants

(k) Naturally occurring or pollution induced toxic elements :

②	— ①	— ⑤	— ③	— ⑥
Younger alluvium (As)	Older Alluvium & Terraces (Fe, I-deficient) NO_3 & F	(Cu-Pb-Zn, Hg, S & Radioactivity in hotsprings & Mn)	FeS / PbS	Radioactive elements

(I) Presence of economic mineral deposit :

②	③	⑤	⑤	④	①	⑥
Brick Clay sand & Nitrate	Pyrite, Galena, Limestone & Tiles	Construction Material, Mineral Water, China Clay & Steatite	Tiles & Silica	Coal & Fire -clay	Gravel/ Pebble/ Boulder	Mica Ceramic Minerals, Radioactive minerals & Gemetones

3.1.1.2. GEOMORPHOLOGY :

Based on broad geomorphic parameters such as relief, drainage pattern and geology Bihar may be divided into three geomorphic domains.

(i) Uplifted block of hilly southern highlands comprising the northern part of the Kodarma- Santhal Pargana planation surface, falling in parts of Bihar, northern fringe or escarpment of Chotanagpur plateau and Rohtas plateau

(ii) The transition zone between the southern highlands and the Great Ganga Plains, constituting the central Bihar Plains, and

(iii) The Ganga foredeep of the North Bihar Plains bounded by the rising Himalaya in the north and the Ganga R. in the South.

The geomorphic units (ii) and (iii) constitutes the part of Middle Ganga basin. The Southern hills demarcates the Mid-Ganga basin along the 150 m contour.

Rohtas Plateau : This plateau rises sharply above Sone river to an height of over 500 m above msl. This plateau slopes down to the north and manifests steep faulted escarpment to the south.

Koderma Santhal Pargana Plateau : This plateau has a gentler easterly slope into the Santhal Pargana plains, which has elevation in the range of 150-300 m above msl except for isolated hills.

Indo-Gangetic Plains : The Ganga foredeep basin as a whole and the river systems e.g. Gandak-Son, Ganga-Gandak & Kosi in particular have been studied in an effort to evaluate the alluvial geology and cause of natural disaster and other hazards. The various morpho-litho-stratigraphy of Alluvial Sediments of Ganga plains are shown in Table 8 to 8.

TABLE - 6

Correlation of morpho-litho-stratigraphy of Quaternary sediments of Bihar Plain South

Morphostratigraphy	Lithostratigraphy		Geological Time
Present Flood Plain : Landforms : Channel bars: Riffles (Diaraland) Erosion and Valley trenching	Alternation of sand, silt and clay Erosional Unconformity		Present day to late holocene Late Holocene
Older Flood Plain : Landforms: Levee, Levee splays, Backswamp, Buried channel, aggraded channel and abandoned channel; and colluvial deposits over pediment	**Ganga Formation :** (b) Silt, clay and sand along E.W Elongation by the side of Ganga River. **Magadh Formation :** (a) Silt, clay and sand : transgressing over the Alluvial Upland and spreading along the valley sides of Durgawati. Son, Punpun, Morhar, Phalgu, Harohar, Kiul, Badua and chandan drainage systems		Holocene
Erosion and valley trenching	**Erosional unconformity** Upper older Alluvium Formation : (iv) (b) pedalfer soil paleosol yellowish gray silt (2 to 8m) Local erosion (a) Aeolian sandy silt/ Pedalfer soil (0.5 to 1.5 m)	K H A D A R	Early Holocene
	Local erosion		

Alluvial Upland : Occurring as terraces and colluvium deposit over pediment	(iii) Pedocal soil Palaeosol Yellow silt & clay (10 to 40 m) brown sand (10 to 20 m)		
	Erosional Unconformity Lower Older Alluvium Formation : (ii) Pedalfer soil Paleosol yellow reddish brown silt and clay (15 to 35 m) Brown sand with gravel (35 to 50 m) Local erosion (i) Yellow to reddish brown Silt and clay (5 to 18 m) Pebble and boulder bearing gritty-sandy bed (local) (local) (5 to 15 m)	B H A N G A R	Upper Pleistocene
Pediplain	**Residual Soild**		**Pre-Quatenary & Quaternary**

TABLE - 7
Correlation of Morpho-lithostratigraphy of Gandak-Kosi interfluve.

Lithostratigraphy	Morphostratigraphy	Lithology	Thickness (m)
	Present Flood Plain : Gandak/Burhi Gandak/Kosi recent alluvium (channel bars and point bars)	Grey micaceous sand	5.0 to 8.0
Newer Alluvium : KHADAR (Up. pleistocene to recent)	Older Flood Plain : Gandak / Burhi Gandak / Kosi-Terrace : Upper Vaishali member (b) Upper Jainagar Member (a) (levee, flood basins)	(b) Interbedded grey to yellowish grey silt-clay, rich in shells, unoxidised soid at places. bog soil at bottom	0.50 to 4.0
	Disconformity		
Older Alluvium : BHANGAR (Mid. - Up. Pleistocene)	Gandak basin : Lower / Vaishali member (b) (exposed at Hazipur) Kosi basin : Lower Jainagar Member (a) (exposed at Khajauli)	(a) Dissected, irregular outcrop of unxidised to feebly oxidised grey to pale yellowish grey silty clay. Soft ferruginous concretions and rare Kankars (Kosi) and pedocal Palaeosol (Gandak.)	2.0 m to 4.0

Unconformity			
	Madhubani Formation (Kosi) Mirganj Formation (Gandak)	Patchy and irregular occurrence of deep yellow to brownish yellow clay with pedocal palacosol lower part arenaceous	> 200

TABLE - 8

Correlation of morpho-litho-stratigraphy of Kosi-Mahananda interfluve.

Morphostratigraphy	Lithology	Lithostratigraphy	
Age Diara Plain Landforms : Channel bars, point bars; Sand dunes. Sand splays.	Overlapping atternation of grey fine sand with occasional silt or clay. No mature soil.	Diara Formation	Present day
Ganga-Kosi-Mahananda plain : Erosional surface on purnea surface.	Alternate sequence of light yellow fine sand and silt with occasional silty clay/ clay. Mainly clay and silty clay in the domain of the Ganga. Thin azonal unoxidised soil. The erosional plain on Purnea surface consists of hard clay and silt of Purnea formation.	Ganga-Kosi-Mahananda Formation	Holocene
Purnea Surface	(a) Flood plain facies : In the north eastern part of the Kosi Fan and in the Ganga-Kosi interfluve flood plain equivalent is represented by alternation of yellow compact silt and yellowish grey clay with shells of gastropod in Kosi-Ganga interfluve and iron coated rock fragment in the outer margin of Kosi fan. (b) Fan facies : Within the Kosi fan this constitute mainly light brownish yellow sand of various size grades : sand size increasing towards depth with occurrence of pebbles.	Purnea formation	Holocene

In absence of any data on absolute age of lithostrata, it has always remained a handicap to correlate the formations occurring on either side of Ganga river. On the basis of the occupation level in basin, Sediment characteristic, degree of oxidation and palaeosol nature the various formations are grouped in the category of Older Alluvium (Bhangar) of Middle to upper Pleistocene age and Newer Alluvium (Khadar) of Upper Pleistocene to Recent age (Pascoe, 1964). Apart from the presence or absence of calcareous nodules within the Bhangar and Khadar soil profile respectively, the neotectonic framework has also helped in the construction of chrono-stratigraphy. It is worthwhile to mention here that NE-SW lineament recorded in Son basin continues in the Western Kosi basin and again NW-SE lineament of Kiul-Kharagpur hill re-emerges in the Gandak-Burhi Gandak Basins. These two lineaments are the connecting links between north and south morphotectonic set-up. This signature has been further modified by E-W cross faults along Ganga channel as evident by swelling of channel and their southeast drag under the influence of NW-SE cross faults, recorded by pinching of channel, occurring in en-echelon manner. Thus the vertical and lateral movement of rivers, and consequent pilling up of alluvium, are due to various reasons, e.g., subsidence, over-sedimentation, climate, neotectonics, hydrodynamics of river basin and advance or retreat of glaciers. The geological and geographical distribution of various formations are shown in Plate No. 4

Central Bihar Plains : Three land systems have been identified e.g.

(i) The Alluvial upland (ii) the Older Flood Plain and (iii) the Present Flood Plains – the domain of deposition during the Quaternary period.

The Alluvial upland constitute the Oldest and highest terrace, traceable from Kaimur Plateau north margin to Bhagalpur and dissected by the northerly flowing parallel drainage systems. The Older Flood Plain constitutes the intermediate terrace and comprises of two land systems (1) a narrow linear east-west arrangement of levee and backswamps (Tal), and palaeodrainage imprints in the area from Patna to Sahibganj, parallel to the course of

Ganga and (2) interfluvial land form morphology evolved in response to Durgawati, Son, Punpun, Morhar and Kiul river systems impressed upon the eroded basement of Older Alluvium, in segments. The Present Flood Plain Constitutes the present oscillatory limit of the Ganga and within channel deposits of northerly flowing channels.

It covers an area of 42,000 sq. km. of flat alluvial plain with a number of isolated hills e.g., Rajgir hills of Nalanda, Kharagpur hills of Munger and Barabar Hills of Gaya. This plain is divided into three interfluvial domains.

(i) Ganga-Son interfluve of Rohtas-Bhojpur & Arwal-Jehanabad-Patna Plains.

(ii) Son-Kiul interfluve of the middle block of Magadh Plains, and

(iii) Chandan-Badua interfluve of the eastern block of the Kiul -Rajmahal Ganga Plains.

The gradient of the central Bihar plains sloping down from the Chotanagpur Plateau to the Ganga are steeper than the Himalayan foothills down to the Ganga in the North.

North Bihar plains : It extends from the course of Ganga in the south to Himalayan foothills in the north. The 'tarai' belt in the north forms the northern part of the Paschim Champaran District and is about 32 km long and 6-8 km wide, rising above plains sharply along the 150 contour, are composed of poorly consolidated boulders, pebbles, and gravels. South of the tarai belt is the North Bihar plains of riverine cones and intercones. Further, the North Bihar Plains can be divided into (i) Gandak-Kosi interfluve and (ii) Kosi-Mahananda interfluve. The Gandak-Kosi-Mahananda interfluve manifests numerons oxbow lakes, tals, abandoned channels and meander scrolls. In the extreme north the tarai (wet land) is followed by subtarai belt of marshy land with intervening patchy occurrence of upland, which is again followed in the south by another marshy low lands, devoid of uplands. Further, towards the South lies the upland till Ganga levee or flood plain is reached.

3.1.1.3. PEDOLOGY :

The role of soil as natural asset of ecosystem is viewed through three angles (i) supporting agriculture & forest (ii) Supporting engineering installation and (iii) Constituting the medium to regulate the storage and accumulation of subsurface water.

For agricultural input the top soils of North and central Bihar are continuously under alluviation along flood plains through annual flooding and deposition. Thus the top soil characteristics perpetually changes and descriptions have to be viewed through temporal change.

The Govt. of Bihar has carried out the systematic Survey of Soils of Bihar as part of their Five year Plan since 1954. More than 3 million hectares have been surveyed in detail, mainly to meet the needs of the irrigational Command Area Development Agencies and the Advance planning wing of the Irrigation department, Government of Bihar.

Soils of Bihar have been grouped into 24 soil associations - combination of Taxonomy types. These are summarised in the detail index to the soil association map presented in Plate No. 5(B). These soils are covered by seven orders, viz affisols, entisols, inceptisols, ultisols, aridisols, mollisols and histosols [Plate 5(A)]. The detailed surveys are confined to the command areas of major river system, viz. Son. Gandak and Kosi and the information presented are skewed in favour of local ground setting.

Soil of Central Bihar

Soil of central Bihar have evolved largely on the alluvium of the Son and the several smaller river systems, namely the Karmanasa, Punpun, Phalgu, Panchane, Sakri, Harohar, Badua and Chandan draining the northern slopes of the Chotanagpur Plateau. The soils are basically an outcome of landform, climate, landuse, topography, time and parent material, which have been well considered during the pedological investigation. The various soils of the area are summarized below.

Colluvial Soil : To the immediately north of the Rohtas and Chotanagpur plateau margin, the colluvial soil occur in a narrow belt with light texture and poor fertility, high slope and undulating topography. They comprises angular gravelliferrous, silty and loamy clay.

Sedentary Soil : They have been studied in detail in Nawada district and are reddish

brown to pale yellow in colour and light to medium texture. They are slightly acidic to neutral (pH = 6.1-7.8), low in soluble salts, low to medium in organic carbon (0.02-1.2%), low to high in available P_2O_5 (7-86.5 kg/ha) and high in available K_2O (105-440 kg/ha). They comprise an association of vertisols, entisols, alffisols and ultisols.

Alluvial Soils : These are prominently developed in the mid - plains in parts of Sasaram and Bhojpur districts west of Son, North of Rajgir hills in parts of Patna, Jehanabad and Gaya districts and along an east-west belt fringing the Tal belts of Soils in parts of Munger-Bhagalpur districts, on the Southern bank of Ganga. These are light coloured poorly fertile soils, that develop cracks on drying. They are mainly an association of vertisols (Soil Assnl. 11) and rest of the plain is covered by soil association (Soil Assn. 12) [Refer Map Plate No. 5(B)]. They are mildly acidic to neutral in reactivity but locally mildly alkaline (pH = 6.8-8.4). They are low in free $CaCO_3$ (0.59-5.30%), poor in soluble salts, low to high in available P_2O_5 (18-65 kg/ha) and available K_2O (15-744 kg/ha). The soils are often characterized by ferruginous and calcium carbonate concretions, either throughout the profile or confined to the lower layers. Along the foothills of Adhaura range the soils are yellowish red to yellow alfisols (soil Assn. 14). The Tal belt South of Ganga is some 8 to 15 km wide. The soils are dark coloured and heavy textured and are alkaline (pH-7.0-0.8). The soils comprise variants of Vertisols (Soil Assn. 10). In the topographic low micro-watershed areas heavy textured soils comparable to black cotton soils or vertisoils.

Diara Soil : Soils developed along the Ganga river banks are whitish to light grey in colour and alkaline with pH of around 8.0 and moderately fertile (Soil Assn. 8). Noncalcareous levee soils are found along the banks of the Son, the Phalgu, Kiul, Chandan and other rivers. They are light in texture and poor in fertility. (Soil Assn. 7).

Soils of North Bihar Plains

The soils largely falls under entisols with several variations brought about due to vagaries of highly mobile fluvial sedimentation. Soils of older landform have developed ferruginous and calcareous concretions and an pedalfar horizon.

Sedentary Soil : These soils are sandy to loamy in texture and are brown to yellow and grey in colour. Generally of a meter-scale thickness, the soils support forest and tall grases and are rich in organic matter. They are developed over the Siwalik sediments of west Champaran districts.

Tarai Soil : Along the border of Nepal and South of the Siwalik Hills are the tarai soils, occuring over a belt 3 to 8 km. wide. In the western parts these soils are unusually heavy in texture and have neutral to moderately acidic reactions. Towards the SE light textured soils are present due to the influence of the Kosi and Mahananda rivers.

Soils in Megafans and Interfluve

The Kosi megafans supports soils that are light coloured, coarse to medium textured and notably micaceous. The soils are moderetely acidic to lightly alkaline (pH - 5.8-8.1) with low free $CaCO_3$ content and low free P_2O_5 (4.6-24.8 kg/ha), low soluble salts and low to occasionally high organic carbon. These soils often poses problems of acidity. However, some of the low lying areas, as for example SE of Saharsa, (The Babhangaon-Nawabganj association) support soils with olive-green colour, sandy-loam texture, high alkalinity (pH - 7.7-8.2) with problems of water logging and alkalinity.

The Gandak fluvial regime is generally characterised by light to dark-grey soils in the uplands and olive-grey to olive-green soils in the low lying areas. They have medium to heavy texture, low permeability, moderate to strong alkaline reactivity (pH - 6.8-8.4, rising to > 10% in places) and low to high free $CaCO_3$ (to 15%). Free P_2O_5 Content is variable (14-396 kg/ha), variable organic carbon (0.17-0.81%) and generally high free K_2O (14-396 kg/ha). Potash content in the Paharpur-Harsih area of East Champaran is as high as 1320 kg/ha. $CaCO_3$ content in these soils is also high (10.1-58-6%). In several areas, as for example in the Barharia-Panchrukhi-Manjhi area of Siwan and Gopalganj districts, salt affected soils cover large areas.

Another distinctive belt of soils extend from Motihari, Sitamarhi, Madhubani and Darbhanga and ends upto where it abuts the curvilinear course of the Kosi. This belt is traceable further and abruptly ends against the western limits of the Kosi Megafan. Soils along this belt are non-calcareous and non-saline. They are characterised by light grey to grey and olive-grey colour, medium to heavy texture, moderate to slow permeability, high alkalinity (pH - 8.2-8.5) and high free $CaCo_3$ Content (>15%).

3.1.1.4. SURFACE WATER

The hydro-morphometric parameters of the various river basins of North Bihar Plain are summarised in table 9 and also represented at plate no. 6

TABLE - 9

Characteristics of river classes (Sinha & Friend, 1994)

Parameter	Mountain Fed (Mt) (Gandak & Kosi)	Foothill Fed (Ft.) (Bagmati)	Plain Fed (Pl.) (Burhi Gandak)	Mixed Fed (MX) (Kamla-Balan)	Order of Magnitude
1	2	3	4	5	6
1. Catchment Area	Very large	Moderate	Moderate	Small	Mt>Ft>Pl>Mx
2. Total length	Very large	Moderate	Moderate	Small	Mt>Ft>Pl>Mx
3. W/D ratio	High (u/s)	Low (u/s<d/s)	Low (u/s<d/s)	Low	Mt>Ft>Mx>Pl
4. Channel Pattern	Braided throughout	Braided (u/s) Meander (d/s)	Meander	Braided (u/s) Meander (d/s)	
5. Sinuosity	Low	Moderate	High	High	Mx>Pl>Ft>Mt
6. Discharge	Peak Very high Early rise (u/s<d/s)	Moderate Peak Low Monsoonal (u/s<d/s)	Very Moderate Peak Very Low Monsoonal (u/s<d/s)	Very Moderate Peak Very Low Monsoonal (Ft<Pl)	Mx>Ft>Mx>Pl
7. Sediment Concen-tration	Very Low	High	Fairly High	High	Mx>Pl>Ft>Mt
8. C/F Vs. discharge	Stable	Decreasing	Decreasing		
9. Sediment Yield	Very High	Low	Fairly high	High	Mt>Pl>Mx>Ft

u/s, m/s and d/s distinguish stations that are upstream, middle and downstream relative to each other.

C/F = Critical Flow

TABLE - 10

Catchment characteristics of North Bihar Plains (Sinha & Jain, 1998)

River	Total lenth (km)		Total Catchment (km)		Upland/Plains area ratio
1	2		3		4
Gandak	625	260	45035	4188	3.33
Kosi	736	260	59503	11410	5.31
Burhi Gandak	431	320	13191	9601	0.00
Bagmati	330	394	8439	6500	0.68
Kamla-Balan	226	120	11347	4488	0.19
Total Catchment area	The area of the catchment measured from the source of the river to the confluence of the mouth with the Ganga.				
Length	Total river length from the source to the site or to the confluence with the Ganga.				
Upland / Plains area ratio	Ratio of the catchment area above the mountains from to that below this.				

The Water Sediment Flux as measured at different stations have estimated that the water transferred is of the order of 1298×1011 kg/yr. and the sediment transferred is of the tune of 161×10^9 kg/yr.

The central Bihar rivers e.g. Karmnasa, Durgawati and Dhamauti take their rise at Rohtasgarh Plateau with NE trending lineament. They drain down the Ganga-Son interfluve. The other important river Son flows along the faulted southern margin of the Rohtasgarh plateau. It takes turn, around the eastern edge of Rohtasgarh plateau, towards NE and drains into Ganga near Maner.

The other rivers are Punpun-Morhar group, which merges and flows into Ganga. Several other streams e.g., Dardha, Phalgu, Paimar, Dhadhar and Sakri emerge from Chotanagpur Plateau. These rivers have tendency, along Jehanabad-Munger axis to split

into number of small distributory streams and rejoins to finally form a stream that runs close to and parallel to Ganga and joins Ganga near Surajgarha. The Barnar and Kiul rivers draining the NE extremities of Bihar Mica belt also meet this stream before merging with Ganga. The stream e.g., Badua and Chandan, draining the southern upland, flows directly into the Ganga. Catchment characteristics of north Bihar plains are shown in Table 10.

The Waterlogging in the Bihar State is mainly due to surface ponding of water during rainy season. The riverbeds in the state are full of silt and there are poor drainage conditions, which result in accumulation of water in Kharif season and subsequently in rabi and summer seaon depending upon water volume. Erratic rainfall and poor sub surface drainage area also cause for waterlogging in the state. Exessive canal irrigation in rabi season is also cause for waterlogging of seasonal nature in many commands of Bihar. In many command areas falling in North Bihar, rice is cultivated in most of the chaur or depression areas where standing water can be seen in rainy season and even in winter. Farmers throw seeds in the chaur during May-June. During rainy season when the water gets accumulated in the depression or chaur, height of rice plant increases. The crop is ready to harvest after water recession. Sometimes if the water remains in the chaur, then the rice crop will remain as it is. Harvesting mainly depends upon rainfall and amount of water in the chaur. Total waterlogged area in Bihar is 627.888 thousand ha. The twin problem of waterlogging and soil salinity caused by natural or anothropogenic processes is a majorenvironmental hazard and threat to agricultural production. Crop growth reduction due to salinity is generally related with higher osmotic potential of soil solution in the root zone. As salinity levels increase, the plant must spend more energy to take up water from the same soil water pool. high soil salinity can also cause nutrient imbalances, result in the accumulation of toxic elements. Besides, salinization causes loss of large areas of formerly productive lands. In fact, the irrigation development in the arid zone usually has to deal with secondary as well as with primary and fossil salinity. This primary and fossil salt mobilization

has been found to be one of the principal causes of the river's salinization in irrigated basins in the arid zone. Waterlogging has very bad effect on the ecosystem like temperature stratification, variation in nutrient contents and dissolved oxygen at different level. Reduced dissloved oxygen affects the aquatic and riparian lives. The methane gas released by waterlogged area is an element of green house effect. Due to waterlogging, major diseases as malaria, polio, foot rot, liver fluke infestation and other diseases of animals and plants (as root-rots) also occurs. So there is an urgent need to remove the congestion of drainage and to reclaim these areas for better environmental condition.

River erosion in Bihar is one of the important issues. About 325 river erosion sites have been identified in the State. The number of sites in each river is presented in Table 11

Table 11

No. of Erosion sites in the River of Bihar

Sl.No.	Name of River	No. of erosion sites
1.	Ganga	60
2.	Mahananda	30
3.	Kosi	75
4.	Kamla	20
5.	Burhi Gandak	30
6.	Ghaghra	10
7	Gandak	70
8.	Bagmati	30

A little over 26 lakhs ha irrigation potential has been created in the state out of which 16 lakhs ha are utilized. Irrigation potential created and utilized district wise are presented in Table 12. Districtwise waterlogged area is presented in Table 13.

Table - 12

IRRIGATION POTENTIAL CREATED AND UTLISED, DISTRICT WISE (in lakh ha.)

Sl. No.	District	Irrigation Potential Created				Irrigation Potential Utilised			
		Kharif	Rabbi	Garma	Total	Kharif	Rabbi	Garma	Total
1	2	3	4	5	6	7	8	9	10
1.	Aurangabad	1.508	0.227	0.000	1.735	1.261	0.245	0.000	1.506
2.	Gaya	0.405	0.080	0.000	0.485	0.149	0.029	0.000	0.178
3.	Arwal	0.322	0.049	0.000	0.371	0.226	0.031	0.000	0.257
4.	Bhojpur	0.907	0.567	0.000	1.474	0.736	0.381	0.000	1.117
5.	Buxar	0.655	0.459	0.000	1.114	0.523	0.321	0.000	0.844
6.	Rohtas	2.521	1.134	0.000	3.655	2.043	0.718	0.000	2.761
7.	Kaimur	0.959	0.540	0.000	1.499	0.817	0.350	0.000	1.167
8.	Patna	0.020	0.082	0.000	0.102	0.307	0.018	0.000	0.325
9.	Nalanda	0.310	0.053	0.000	0.363	0.147	0.012	0.000	0.159
10.	Nawada	0.350	0.043	0.000	0.395	0.158	0.010	0.000	0.168
11.	Shekhpura	0.139	0.025	0.000	0.164	0.091	0.006	0.000	0.097
12.	Jehanabad	0.360	0.060	0.000	0.420	0.167	0.014	0.000	0.181
13.	Lakhisarai	0.376	0.060	0.000	0.436	0.263	0.044	0.000	0.307
14.	Bhagalpur	0.155	0.029	0.000	0.184	0.115	0.022	0.000	0.137
15.	Munger	0.288	0.053	0.000	0.341	0.213	0.041	0.000	0.254
16.	Jamui	0.289	0.057	0.000	0.346	0.228	0.044	0.000	0.272
17.	Banka	1.018	0.211	0.000	1.229	0.762	0.162	0.000	0.924
Total (Central Bihar)		**10.584**	**3.729**	**0.000**	**14.313**	**8.205**	**2.448**	**0.000**	**10.653**
18.	West Champaran	1.395	0.775	0.158	2.328	0.7725	0.336	0.081	1.1895
19.	East Champaran	0.665	0.338	0.069	1.072	0.34	0.145	0.035	0.52
20.	Saran (Chhapra)	0.521	0.400	0.019	0.940	0.399	0.179	0.000	0.578
21.	Siwan	0.833	0.451	0.022	1.306	0.641	0.203	0.000	0.844
22.	Gopalganj	0.729	0.474	0.025	1.228	0.553	0.215	0.000	0.768
23.	Muzaffarpur	0.255	0.118	0.021	0.394	0.098	0.014	0.000	0.112
24.	Vaishali	0.013	0.024	0.004	0.041	0.024	0.003	0.000	0.027
25.	Supaul	0.849	0.295	0.207	1.351	0.414	0.000	0.000	0.414
26.	Madhepura	0.400	0.085	0.058	0.543	0.205	0.000	0.000	0.205
27.	Purnia	0.390	0.182	0.103	0.675	0.193	0.000	0.001	0.194
28.	Araria	0.316	0.185	0.108	0.609	0.146	0.000	0.001	0.147
29.	Katihar	0.044	0.044	0.024	0.112	0.017	0.000	0.000	0.017
30.	Saharsa	0.109	0.060	0.042	0.211	0.062	0.000	0.000	0.062
31.	Madhubani	0.78	0.137	0.079	0.996	0.413	0.007	0.000	0.420
Total (North Bihar)		**7.299**	**3.568**	**0.939**	**11.806**	**4.277**	**1.102**	**0.118**	**5.497**
Grand Total		**17.883**	**7.297**	**0.939**	**26.119**	**12.482**	**3.550**	**0.118**	**16.150**

Table - 13
Districtwise Waterlogged Area

Sl. No.	District	Total area in '000 ha
1.	Araria	26.885
2.	Aurangabad	2.464
3.	Banka	3.965
4.	Begusarai	2.908
5.	Bhabhua	10.822
6.	Bhagalpur	12.033
7.	Bhojpur	23.105
8.	Buxar	12.262
9.	Darbhanga	20.251
10.	East Champaran	34.394
11.	Gaya	5.651
12.	Gopalganj	21.692
13.	Jehanabad & Arwal	12.493
14.	Jamui	1.594
15.	Katihar	38.404
16.	Khagaria	2.07
17.	Kishanganj	12.98
18.	Lakhisarai	16.676
19.	Madhepura	14.222
20.	Madhubani	11.486
21.	Munger	5.337
22.	Muzaffarpur	32.692
23.	Nalanda	23.063
24.	Nawada	4.944
25.	Patna	62.38
26.	Purnia	36.3
27.	Rohtas	4.005
28.	Saharsa	9.277
29.	Samastipur	18.074
30.	Saran	32.34
31.	Sheikhpura	1.789
32.	Sheohar	2.004
33.	Sitamarhi	4.947
34.	Siwan	23.048
35.	Supaul	24.707
36.	Vaishali	34.495
37.	W. Champaran	22.127
	Total	**627.886**

(Source: Water Resources Department, GoB)

3.1.1.5. GROUND WATER :

The water bearing properties are the main guiding lines for grouping the geological formations of Bihar. On this basis, four main subdivisions are made;

A Main alluvial basin with good ground water potentialities having considerable granulose zone with effective porosity.

B. Marginal alluvial terrain which forms a part of the alluvial tract, but is dominated by finer clastics or inadequate alluvial thickness and granular horizons fringing the hard rock terrain and the localised alluvial pockets in the rocky terrain, viz; near rivers and in valleys (20-30 m of alluvium).

C. Hard rock terrain, comprising the entire Archaean terrain and Vindhyan hill areas with very little groundwater potentialities.

D. Soft rock areas, viz; Gondwana and Tertiary areas.

Hydrogeological parameters of the state has been depicted in the [Plate No. 7 (A & B)]. On the basis of geological and geomorphological set up and characteristics of aquifers, Bihar can be divided into two broad hydrogelogical units, (1) fissured formations and (2) porous formations. The details of the characterisation of consolidated/ semi-consoliated / unconsolidated formations in terms of age group, lithology, hydrogeological conditions and ground water potential are summarised in the Plate No. 7 (A) & 7 (B).

3.1.1.6. LAND USE

The land use parameter plays an important role in agricultural economics. In Bihar more than 80% of the area is cultivable land out of which 60% is under net sown area (Refer Plate 8). The forest land constitutes 7% of the total area. More than 80% of the population depends on agricultural activity and the average holding is less than 0.4 ha. One of the leading problems of Bihar is to find how best the land use is made effective in

order to have intensive agricultural output.

In the districts of Patna, Nalanda, Bhojpur, Rohtas, Buxar, Kaimur and Jehanabad all the aerable lands are under cultivation because of the availability of assured irrigation either through tube-wells or canals. The area under more than one crop yield is variable in different districts. In Patna and Nalanda districts it covers very close to cent per cent. The net area sown in Saran, Gopalganj and Siwan comes to 98%, in Muzaffarpur, Sitamarhi, Seohar and Vaishali districts it is 95%, in Madhubani, Darbhanga and Samastipur it is 87% in Gaya, Aurangabad and Jehanabad it is 86.7% and in Purbi and Paschim Champaran it is 84%. The existing land use pattern could be grouped under following nine classes :

(i) Pure agricultural area (61%)

(ii) Culturable wastelands (10.7%)

(iii) Barren and inculturable land (2.1%)

(iv) Orchards (1.7%)

(v) Aerable waste land (1.1%)

(vi) Non-aerable land (13%) under other than agriculture

(vii) Pasteures (0.4%)

(viii) Forest (7%)

(ix) Rock & Reh land (3%)

3.1.2.1. Meteorology

The state has a tropical monsoon climate with three distinct seasons-winter, summer and rainy. The climatic conditions of state vary with its physiographic set-up. Broadly the state can be divided into three climate zones.

(a) The Sub-Himalayan zone (b) The Ganga plains zone and (c) The parts of Chotanagpur plateau zones of South Bihar.

(a) The Sub-Himalayan zone : The Sub-Himalayan zone in the northern part of the state receives high incidence of rainfall over 1400 mm, bulk of which is found to occur during the monsoon season from June to September. The mean maximum temprature is 43°C and the mean minimum temperature is 4°C.

(b) The Ganga plains : The Ganga plains zone forms an excessive bowl of warm air, especially during day time. The mean maximum daily temperature even the coldest month (January) nowhere falls below 21°C. Hot season in the zone covers the period from April to June, May being the hottest month in the greater part of the area. West of Gaya the daily mean maximum temperature in May rises to 40°c and above, the mean daily maximum air temperature being as high as 41.3°C at Gaya. The cold weather period extends from December to February, January being the coldest month when temperature falls below 10°C, especially in the valley west of Gaya where daily maximum temperature for the month of January touches 10.1°C. In lower Ganga plain, the minimum temperature is somewhat higher being 11°C at Patna. The onset of monsoon normally occurs in early June in the Lower Bengal and by the end of July, the monson establishes itself over the entire Gang Plain and results in heavy downpour and triggered off everywhere till the end of September. The geographic distribution of the mean annual rainfall is shown by contours in the Plate No. 9.

(c) The parts of Chotanagpur plateau: The maximum summer temperature ranges from 46°C in the western part to 42°C in the east, the annual rainfall ranges from 800 mm in the western part to 600 m in the eastern part.

3.1.2.2. Air quality

The raw data on Air quality for Shastri Nagar and Gandhi Maidan, Patna for the period 2000-01 to 2004-05 are presented in Table No.14 to 23.

3.1.2.3. Noise Level

Automobile revolution in urban area has proved to be a major cause of noise pollution. The movements of heavy trucks, buses, trains, jet-planes, three wheeler tempos motorcycles, scooters, mopeds, jeeps falls under the list whose cumulative sound outcome is the noise pollution.

Typical ambient noise level monitoring of Patna, Muzaffarpur and Gaya towns during the year 2004-05 are presented in Table 24 to 26.

3.1.2.4. Socio-Economy

Bihar has tremendous human resource, fertile agricultural land and eco-friendly tourist resorts with their optimum utilisation potential in the backdrop of growing population. It has also been the choosen place for major public sector projects like refinery, fertiliser product and power generation. Every year many foreign tourists come to Bodh Gaya, Rajgir and Vaishali. The Madhubani paintings has been attracting the attention world over and could be revived and commercialised.

The main thrust of socio-economy lies in the agricultural sector and the peripheral rural agro-industries. The land and water management programmes by the state govt. in the irrigational command areas and the development agencies viz; (i) Son Command Area Development Authority (ii) Gandak command Area Development Authority and (iii) Kosi command Area Development authority have been entrusted with Job to take care of the secured irrigation water need, the proper maintenance, marketing of the agricultural produce and related socio-economic measures.

The Govt. of Bihar has contemplated various small & minor irrigation schemes for the identified drought prone areas.

TABLE - 14

Bihar State Pollution Control Board, Patna

AMBIENT AIR QUALITY DATA FOR THE YEAR 2000-2001

Location : Gandhi Maidan - Patna

MONTH	SULPHUR DIOXIDE				OXIDES OF NITROGEN				SUSPENDED PARTICULATE MATTER			
	Min.	Max.	Mean	N	Min.	Max.	Mean	N	Min.	Max.	Mean	N
April' 2000	8.5	27	17.3	69	11.2	31.5	22.8	69	297	2644	894	39
May' 2000	7.2	18.9	16.1	96	9.8	26.1	19.9	96	210	808	492	50
June' 2000	5.9	17.2	14.6	58	9.5	21.9	18.4	58	101	327	204	29
July' 2000	5.1	19.1	13.7	60	7.2	26.4	18.4	60	43	464	221	30
Aug.' 2000	6.2	21.9	13.4	57	7.5	26.6	16.3	57	59	555	236	29
Sept' 2000	5.2	24.3	13.6	59	7	29.2	18	59	45	734	306	30
Oct.' 2000	7.8	27	16.3	81	9.9	32	19.8	81	178	826	431	42
Nov.' 2000	9.5	33	19.2	111	12	38	23.3	111	141	1132	626	56
Dec.' 2000	10	35.5	20.8	120	13.9	39.2	24.2	120	418	1937	902	60
Jan.' 2001		36	19.6	113		40	22.6	113	302	1377	846	87
Feb.' 2001		27	16.3	114		33.4	21.4	114		934	751	87
Mar.' 2001												
Annual	5.1	36	16.4	983	7	40	20.5	938	43	2644	537	539

Note : Units are in µg/m³ ; N – number of observations.

TABLE - 15

Bihar State Pollution Control Board, Patna

AMBIENT AIR QUALITY DATA FOR THE YEAR 2000-2001

Location : At Beltron Bhawan, Shastri Nagar, Patna

MONTH	SULPHUR DIOXIDE				NITROGEN OXIDE				SUSPENDED PARTICULATE			
	Min.	Max.	Mean	N	Min.	Max.	Mean	N	Min.	Max.	Mean	N
April' 2000	3.7	16.3	10	38	5.6	20	12.6	38	137	327	230	20
May' 2000	4.7	13.2	10.2	60	6.2	14.2	12.3	60	87	237	187	30
June' 2000	4	9.5	8.4	55	6	12	10.5	55	39	127	89.9	28
July' 2000	4.2	9.5	8.6	54	5.3	12	10.3	54	41	152	103	27
Aug.' 2000	3	11.6	6.3	52	3.8	16	8.6	52	38	150	83	25
Sept' 2000	4	11.2	6.6	52	4.8	14.4	8.5	52	56	209	143	25
Oct.' 2000	4.9	15.9	9.2	48	5.6	19	10.9	48	83	202	150	24
Nov.' 2000	4.7	15.7	9.9	56	6.1	19.5	12.7	56	121	227	185	28
Dec.' 2000	5.1	18	11.2	53	6.9	21.5	13.8	53	129	325	203	27
Jan.' 2001	7	18.2	13	47	10	20.5	15.2	47	115	319	205	23
Feb.' 2001		16.9	11.2	48		19.1	13.7	48		297	203	24
Mar.' 2001												
Annual	3	18.2	9.5	563	3.8	21.5	11.73	563	38	327	161.99	281

Note : Units are in µg/m³ ; N – number of observations.

TABLE - 16

Bihar State Pollution Control Board, Patna

AMBIENT AIR QUALITY DATA FOR THE YEAR 2001-2002

Location : At Gandhi Maidan - Patna

MONTH	SULPHUR DIOXIDE				OXIDES OF NITROGEN				SUSPENDED PARTICULATE MATTER			
	Min.	Max.	Mean	N	Min.	Max.	Mean	N	Min.	Max.	Mean	N
April' 01	7.9	23.7	15	56	10.1	28.1	18	56	161	1028	557	28
May' 01	8	22	17.1	56	10	26.6	17.1	56	173	831	456	28
June' 01	4.8	25	13.4	60	6.1	28.2	14.9	60	207	1192	315	30
July' 01	6.3	21.1	13.3	58	7.6	23.9	12.8	58	92	626	263	30
Aug.' 01	7.4	23.2	13.8	58	9	24.2	15.8	58	81	698	243	29
Sept' 01	9.4	26	16.8	38	11.5	27.5	19.7	38	210	578	414	19
Oct.' 01	9.5	23	16.5	39	10.5	26.1	19.4	39	265	675	462	20
Nov.' 01	12.7	27	21	30	14.5	31.5	24.4	30	295	719	5058	15
Dec.' 01	19.6	28.6	24.6	40	23.4	32.5	27.8	40	536	791	628	20
Jan.' 02	10.1	27	18.1	56	12	31	20.9	56	307	702	492	28
Feb.' 02	10.4	23	17.8	44	14	27.9	22.5	44	317	675	523	22
Mar.' 02	11.6	26.4	19.2	40	13.2	29.2	22.4	40	317	673	488	20
Annual	4.8	28.6	17.2	575	6.1	32.5	19.6	575	81	1192	445	289

Note : Units are in µg/m^3 ; N – number of observations.

TABLE - 17

Bihar State Pollution Control Board, Patna

AMBIENT AIR QUALITY DATA FOR THE YEAR 2001-2002

Location : At Beltron Bhawan, Shastri Nagar, Patna

MONTH	SULPHUR DIOXIDE				NITROGEN OXIDE				SUSPENDED PARTICULATE MATTER			
	Min.	Max.	Mean	N	Min.	Max.	Mean	N	Min.	Max.	Mean	N
April' 01	4.6	15.4	9.3	48	5.7	15.4	11.1	48	163	292	220	24
May' 01	4.9	16	9.7	52	5.8	21.9	13	52	162	682	364	26
June' 01	4.9	12.9	8.9	46	5.8	15.8	10.7	46	49	363	274	23
July' 01	4	12	7.7	59	5.2	14	9.4	59	41	225	137	30
Aug.' 01	4.2	14.7	8.2	60	5	17.8	10.7	60	65	189	126	30
Sept' 01	4.5	13.1	7.7	60	5.1	14.4	9.2	60	61	151	102	30
Oct.' 01	4.4	15.3	7.2	59	5.6	17	9.3	59	53	181	112	30
Nov.' 01	4.1	13.3	8.7	54	5.3	18.1	10.8	54	89	193	153	27
Dec.' 01	5	15.4	10.1	60	5.6	19.2	12.3	60	113	266	204	30
Jan.' 02	4.5	15	8.6	57	5.6	21	13.2	57	77	277	177	29
Feb.' 02	4.2	12.8	8.5	60	6.1	22	13.9	60	109	360	239	30
Mar.' 02	5	12	8.9	60	7.2	20.7	13.1	60	144	295	225	30
Annual	4	16	8.6	675	5	22	11.4	675	41	682	194	339

Note : Units are in µg/m^3 ; N – number of observations.

TABLE - 18

Bihar State Pollution Control Board, Patna

AMBIENT AIR QUALITY DATA FOR THE YEAR 2002-2003

Location : At Gandhi Maidan - Patna

MONTH	SULPHUR DIOXIDE				OXIDES OF NITROGEN				SUSPENDED PARTICULATE MATTER			
	Min.	Max.	Mean	N	Min.	Max.	Mean	N	Min.	Max.	Mean	N
April' 02	10	21.7	15.9	52	12.4	24.6	18.5	52	439	702	527	26
May' 02	10.9	24.1	17.8	50	11.5	30	20.9	50	225	812	552	25
June' 02	4	23.9	17.1	48	14	28.8	21	47	322	631	492	24
July' 02	8.4	20.5	15.5	52	10	23	18.5	52	185	465	327	26
Aug.' 02	8.9	20.1	14	50	10.1	24.9	16.4	50	315	695	514	25
Sept' 02	8.5	24	14.5	56	9.5	29.5	17.3	56	91	796	323	28
Oct.' 02	9.4	40.5	19.4	56	12.2	42	22.8	56	163	1155	608	28
Nov.' 02	10.9	29	19.8	57	12	32.7	22.7	57	390	2145	800	29
Dec.' 02	12.7	26	18.6	58	28.5	14	21.4	58	167	815	461	29
Jan.' 03	10.7	23.5	18	60	13.2	27	20.3	60	117	266	175	30
Feb.' 03	7.8	23.5	16.4	48	9.4	25.7	18.5	48	76	1321	184	24
Mar.' 03												
Annual	4	40.5	17	587	9.4	42	19.8	586	76	2145	451	294

Note : Units are in µg/m³ ; N – number of observations.

TABLE - 19

Bihar State Pollution Control Board, Patna

AMBIENT AIR QUALITY DATA FOR THE YEAR 2002-2003

Location : At Beltron Bhawan, Shastri Nagar, Patna

MONTH	SULPHUR DIOXIDE				NITROGEN OXIDE				SUSPENDED PARTICULATE MATTER			
	Min.	Max.	Mean	N	Min.	Max.	Mean	N	Min.	Max.	Mean	N
April' 02	4.2	26	8.6	60	5.7	20	11.9	59	200	304	261	30
May' 02	4.5	12.5	8.1	59	5.2	18.2	11.2	59	138	287	215	30
June' 02	4	13	8.3	53	4.9	17	11.3	53	102	271	183	27
July' 02	4	12.8	7.7	59	4.8	15.9	9.7	59	51	334	144	30
Aug.' 02	4.6	10.8	7.5	59	5.6	13.9	9.3	59	41	208	93	30
Sept' 02	4.7	12	7.5	60	3.9	15.2	9.1	60	40	211	96	30
Oct.' 02	4.5	13.1	8.6	59	5	17.7	10.5	59	45	198	125	30
Nov.' 02	5	18.5	9.3	60	6	20.8	11.3	60	99	227	141	30
Dec.' 02	5.2	40.5	9.1	60	6.4	16.7	10.9	60	35	765	152	30
Jan.' 03	5	11.8	7.9	59	6.1	14.1	9.7	60	37	107	68	30
Feb.' 03	4.7	13.5	8.1	60	5.4	17	10.1	60	24	277	113	30
Mar.' 03												
Annual	4	40.5	8.2	648	3.9	20.8	10.5	648	24	765	144.6	327

Note : Units are in µg/m^3 ; N – number of observations.

TABLE - 20

Bihar State Pollution Control Board, Patna

AMBIENT AIR QUALITY DATA FOR THE YEAR 2003-2004

Location : At Gandhi Madan - Patna

MONTH	SULPHUR DIOXIDE				OXIDES OF NITROGEN				SUSPENDED PARTICULATE MATTER			
	Min.	Max.	Mean	N	Min.	Max.	Mean	N	Min.	Max.	Mean	N
Dec.' 03	8.1	36.4	15.4	48	4.5	146.9	62.2	48	137	634	362	24
Jan.' 04	8.1	23	13.4	62	4.5	121.2	52.4	66	146	327	236	32
Feb.' 04	8.9	125.3	21.3	40	4.5	122	68.6	42	210	523	327	20
Mar.' 04												
Annual	8.1	125.3	16.7	150	4.5	146.9	61.1	156	137	634	308	76

Note : Units are in µg/m^3 ; N – number of observations.

TABLE - 21

Bihar State Pollution Control Board, Patna

AMBIENT AIR QUALITY DATA FOR THE YEAR 2003-2004

Location : At Beltron Bhawan, Shastri Nagar, Patna

MONTH	SULPHUR DIOXIDE				NITROGEN OXIDE				SUSPENDED PARTICULATE MATTER			
	Min.	Max.	Mean	N	Min.	Max.	Mean	N	Min.	Max.	Mean	N
Oct.' 03	5.2	44.1	10.4	120	9.8	21.3	14.8	120	93	149	117	60
Nov.' 03	6.4	108	14.8	167	4.5	62.7	21.8	168	107	352	177	84
Dec.' 03	7.8	32.2	15.3	83	4.5	71.4	34.8	84	135	388	252	42
Jan.' 04	7	20.1	11.8	82	4.5	95.1	33.5	84	123	280	193	42
Feb.' 04	7.9	48.1	15.2	65	4.5	94.7	459	66	151	444	258	33
Mar.' 04												
Annual	5.2	108	13.5	517	4.5	95.1	112.8	522	93	444	199.4	261

Note : Units are in µg/m³ ; N – number of observations.

TABLE - 22

Bihar State Pollution Control Board, Patna

AMBIENT AIR QUALITY DATA FOR THE YEAR 2004-2005

Location : At Beltron Bhawan, Shastri Nagar, Patna

MONTH	SULPHUR DIOXIDE				OXIDES OF NITROGEN				SUSPENDED PARTICULATE MATTER			
	Min.	Max.	Mean	N	Min.	Max.	Mean	N	Min.	Max.	Mean	N
April' 04												
May' 04	5.5	33.3	13.7	66	6.8	61.7	21.6	66	155	669	324	33
June' 04	6.7	46.3	12	66	6.5	29.6	12.6	66	92	433	229	33
July' 04	6.5	31.6	9.7	78	8	32.7	14.4	78	100	284	149	39
Aug.' 04	6.2	11.8	8.8	74	10.3	28	15	74	105	167	134	37
Sept' 04	6.5	13.1	8.6	71	10.2	31.6	16.9	71	111	169	139	36
Oct.' 04	6	17	9.9	66	5.5	40.8	17.5	66	104	234	151	33
Nov.' 04	7.5	183	10.2	36	10.3	28.8	18.7	36	108	219	159	18
Dec.' 04	6.9	15.3	10.5	54	11.6	77.4	24.8	54	104	275	171	27
Jan.' 05	5.6	13.2	9.5	78	9.8	46.2	23.2	78	93	315	165	39
Feb.' 05												
Mar.' 05												
Annual	5.5	183	10.3	589	5.5	77.4	18.3	589	92	669	180.1	295

Note : Units are in µg/m^3 ; N – number of observations.

TABLE - 23

Bihar State Pollution Control Board, Patna

AMBIENT AIR QUALITY DATA FOR THE YEAR 2004-2005

Location : At Gandhi Maidan - Patna

MONTH	SULPHUR DIOXIDE				OXIDES OF NITROGEN				SUSPENDED PARTICULATE MATTER			
	Min.	Max.	Mean	N	Min.	Max.	Mean	N	Min.	Max.	Mean	N
April' 04												
May' 04	8.5	62.6	21.4	53	108	68.8	23.4	53	203	749	422	27
June' 04	7.1	52.8	14.7	71	8.4	42.7	17.1	71	124	522	270	36
July' 04	6.7	16.6	10.7	65	10.5	43.2	20	65	124	309	185	33
Aug.' 04	6.6	17.8	9.5	72	10.4	34.8	19.5	72	116	203	154	36
Sept' 04	5.6	13.5	9.4	74	12.1	40.1	25.2	74	118	207	162	38
Oct.' 04	6.7	23.4	10.8	66	11.1	69.3	30.8	66	109	391	185	33
Nov.' 04	7.7	21.3	8.9	18	19.5	91.4	54.8	18	147	286	230	9
Dec.' 04												
Jan.' 05	5.6	18.4	10	41	9.8	74.8	29.1	41	93	333	189	22
Feb.' 05												
Mar.' 05												
Annual	5.6	62.6	11.9	460	8.4	91.4	27.5	460	93	749	224.6	234

Note : Units are in µg/m³ ; N – number of observations.

TABLE - 24 : Typical Ambient Noise Level Monitoring Report of Patna town (2004-05)

Sl. No.	Sampling Location	Zone Category	Average Ambient Noise level in dB(A) Leq	Day time standards in respect of noise 06:00 a.m. to 10:00 p.m.	Remarks
1.	IGIMS (in front of wards block)	Slience zone	60.2	50 dB(A) Leg	
2.	In front of Raj Bhawan		56.4		
3.	In front of Vidhan Shabha Bhawan		54.6		
4.	High Court Near Bhimrao Ambedkar Statue		74.5		
5.	D.A.V. Public School, BSEB Colony (during school hour)		70.4		
6.	A.N. College Campus (In front of Technical Block)		71.6		
7.	Loyola High School		66.6		
8.	Kurji Holy Family Hospital Campus		62.4		
9.	St. Michael Hih School Campus		53.2		
10.	Magadha Mahila College (Campus)		64.4		
11.	P.M.C.H. Campus		66.4		
12.	Science College, Campus		62.0		
13.	In front of Law College Hostel		69.4		
11.	Rajendra Nagar Hospital		58.3		
12.	N.M.C.H. Campus (In front of main Building)		64.1		
13.	G.P.O. Campus, Patna		72.7		
14.	Patna Museum, Campus		68.4		
15.	A.G. Colony	Residential Zone	60.4	55 dB(A) Leq	Interruption of local vehicular encroachment in the street
16.	Ashiyana Nagar, Phase-1		56.2		
17.	Magistrate colony, Ashiyana Nagar, N. Community Hall.		59.6		
18.	Patliputra Colony Golumbar		70.3		
19.	North S.K. Puri (Near Dr. Gopal Prasad Residence)		62.4		
20.	South S.K. Puri Near Children Park		72.4		
21.	East Patel Nagar		68.5		
22.	P&T Colony, Kidwaipuri		55.2		
23.	S.K. Nagar (Infront of Bank of india) Road no.-25		63.8		
23.	Mc Dowell Golumbar, Near Monuel Haque Stadium, Rajendra Nagar		62.6		
24.	Lohanipur (Infront of Bank of India) Road No.-25		68.2		
25.	Near Magadh Hospital, Rajendra Nagar,		57.4		
26.	Kadam Kuan,		59.3		
27.	Gardanibagh, Road No.-4 Near Durbhash Kendra		68.6		
28.	Gardanibagh Road No.-15, Near Shishu Vidyamandir		74.8		
29.	Kankarbagh Temopostand in front of Bhagat Bhawan		67.4		

Typical Ambient Noise Level Monitoring Report of Patna town (2004-05)

Sl. No.	Sampling Location	Zone Category	Average Ambient Noise level in dB(A) Leq	Day time standards in respect of noise 06:00 a.m. to 10:00 p.m.	Remarks
30.	In front of Geological Survey of India, Kankarbagh, Near Rajendra Nagar Over Bridge		77.6		
31.	In front of Gayatri Shakti Pith (Mandir), Kankarbagh-20		62.4		
32.	Shiv Puri Chuaraha, Chauraha Near Shiv Mandir		66.6		
33.	Rani Ghat area		54.4		
34.	Jagdeo Path	Commercial Zone	78.4	65dB(A) Leg	Local activities as well as traffic
35.	Alapna Market, Patliputra		80.6		
36.	Patliputra Columbar		67.4		
37.	Rajapur Pul		77.4		
38.	Bansghat		71.4		
39.	Boring Road Crossing		76.8		
40.	Maurya Lok Near Swami Vivekanand Statue		70.2		
41.	Dukbunglow Chouraha (Police Control Room)		73.8		
42.	Kargil Chowk		79.8		
43.	Exhibition Road Crossing		73.4		
44.	Infront of Hanuman Mandir (Patna Station)		71.7		
45.	Bir Kunwar Singh Golumbar Near R. Block		84.6		
46.	Ashok Raj Path Near Patna marker		74.2		
47.	Mahendru Post Office		79.2		
48.	Musallahpur Hat		70.9		
49.	Bhikhana Pahari More		70.7		
50.	Kadam Kuan Golambar (Near St. Severin's High School), Patna-4		75.3		
51.	Halthua market		60.8		
52.	Bari path Near Department of education, P.U. (Opposite to Dariyapur mosque)		76.5		
53.	Machhua Toli Chowk (Bari Path Road)		76.1		
54.	Dinkar Golumbar, Nala Road (Infront of Mandir)		74.4		
55.	Chitkohra Market (Gardani bagh)		76.8		
56.	Chirayatand Pul, Near Khasmahal Golumbar		74.6		
57.	Kankarbagh Colony More		72.4		
58.	Bahadurpur Gumati (Near Petrol Pump)		76.3		
59.	Kankarbagh Tempo Stand (Near R.M.L. Guest House)		64.9		
60.	M/s APT Engicone (P) Ltd. Patliputra C-1, Industrial area, Patna - 13	Industrial Zone	57.4	75 dB(A) Leq	Low activities due to poor industrial growth
61.	M/s Tata Engineering Autozone Services (P) Ltd.		72.2		
62.	M/s Mahindra Authorised Dealer Kisanseva Kendra Service Centre, Patna-13		59.6		
63.	M/s Hindustan Coco Cola Beverages (P) Ltd. Patliputra Industrial Area, Patna-13		65.4		
64.	M/s Beltron Training Institute, Patliputra Ind. Area patna-13		62.2		

TABLE - 25 : Typical Ambient Noise Level Monitoring Report of Muzaffarpur town (2004-05)

Sl. No.	Sampling Location	Zone Category	Average Ambient Noise level in dB(A) Leq	Day time standards in respect of noise 06:00 a.m. to 10:00 p.m.	Remarks
1.	Near Juran Chapra Chowk	Commercial	75.7	65 dB(A) Leq	Commercial activities as well as plying of vehicles
2.	Bhagwanpur Chowk		76.8		
3.	Kalyani Chowk, (Com)		71.6		
4.	Aamgola Near Rly Crossing (Train is not crossing)		68.7		
5.	Baiya Bus Stand near Ticket Booking Office		78.8		
6.	Ramdayaloo More		74.2		
7.	Sarai Syed Ali Road, Technical Chowk	Residential	67.4	55 dB(A) Leq	
8.	M.E. Hospital Main Gate	Silence	74.1	50 dB(A) Leq	plying of unauthorized Vehicles
9.	SKMCH, Near Emergency Ward		52.2		
10.	B.R.A. University, Campus		56.4		
11.	Near Kachhari Chowk		72.4		

TABLE - 26 : Typical Ambient Noise Level Monitoring Report of Gaya town (2004-05)

Sl. No.	Sampling Location	Zone Category	Average Ambient Noise level in dB(A) Leq	Day time standards in respect of noise 06:00 a.m. to 10:00 p.m.	Remarks
1.	Near Kashi Nath More	commercial	76.9		
2.	Kachhari Chowk		78.4		
3.	In front of SBI Main Branch		74.4		
4.	G.B. Road Near Kotawali		68.9		
5.	Rang Bahadur Road Chowk, Near Hanuman Mandir		66.4		
6.	Gaya Chowk, Near Columbar		78.6		
7.	Station Road, Gaya		76.2		
8.	New Area Piparpanti	Residential	53.6		
9.	Near S.P. Residence, Gaya		59.2		
10.	Bata More, Swarajpuri		65.8		Non-Residential activities
11.	Tekari More		74.6		....do.....
12.	Kachari Near Civil Court	Silence	76.8		
13.	Near D.P.S. school, Katari Hill Road		58.9		
14.	A.M. College Campus, Gaya		54.4		

3.1.3 BIOTIC PARAMETERS

3.1.3.1 Biodiversity

In an ecosystem there is diversity of species which attracts attention of the evolutionary and ecological factors that had been responsible for such diversification. The species diversity is not so uniform, as the value represented is, unless compared with species diversity in another community. It is the geographical pattern in species diversity that tells us about the factors contributing to diversity. In case of Bihar, the diversity of fauna and flora is noticeable in the backdrop of changing physiographic and climatic zonations and its remarkable longitudinal changes across the Ganga basin.

A rich variety of flora and fauna, we had around the western Chotanagpur plateau where thick forest, sufficient hydrological input, natural abode and food were the essential components of ecosystem, available. What is to be monitored for the biodiversity of prevailing ecosystem, which have been subjected to ravages of human influence, such as pollution and deforestation, is measure of their health and well being. The relative abundance of species is an important component of the measure in a particular landsystem or ecosystem. The concept of species or biodiversity is actually linked wih their actual number and also with the commonness and rarity of species in a particular system. Further, north of this hill-system, occupies the actual Ganga basin, the Tarai and sub-Himalayan tracts. The actual Ganga basin, area where the agroclimatic zonation and land system zonation are the two background layers over which the biodiversity could be well accessed and accounted.

Considering the persistent threat to the survival of many ecosystems on the earth as a consequence of human activities, one would indeed like to find out about the factors that contribute to the stability of a biological community. Stability has been interpreted in different ways. Three concepts of stability may be seen, as indicated below:

(i) the population densities of species remain fairly constant through time - constancy of numbers;

(ii) the community as a whole remians unchanged in the face of any major disturbance, i.e., resistance to perturbation; and

(iii) the community has the ability to return to normal state or equilibrium sooner or later if disrupted by a major disturbance.

3.1.3.2. SOCIO ECONOMIC FACTS ABOUT BIHAR

Population

TABLE - 27 : Decadal Population growth rate (%) 1991-2001

State	Rural	Urban	Total
Bihar	28.3	29.3	28.4
Jharkhand	21.6	29.0	23.2
Chattisgarh	14.2	36.2	18.1
Uttaranchal	15.2	32.8	19.2
Punjab	12.3	37.6	19.8
Maharastra	15.2	34.3	22.6
Tamil Nadu	-5.2	42.8	11.2
W. Bengal	16.9	20.2	17.8
Orissa	13.8	29.8	15.9
India	17.9	31.2	21.3

Source: Jagaran Report, 2001

- Decadal population growth rate for 1991-2001 are given above.
- The above facts give the picture that the population growth of Bihar was more than that of the other states as well as more than the national average.
- There was increase in the urban population growth of the state. In comparison to other states there was less increase in the urban population this is due to low to medium migration of the population from rural to urban.

TABLE - 28 : Percentage of Labour out of total population

State	% of total Labour	% of marginal labour from state	% of non labour outside
Bihar	***25.4***	***8.3***	***66.3***
Jharkhand	23.9	13.6	62.5
Chattisgarh	33.9	12.6	53.5
Uttaranchal	27.4	9.6	63.1
Punjab	32.2	5.3	62.5
Maharastra	35.9	6.6	57.5
Tamil Nadu	38.1	6.6	55.3
W. Bengal	28.7	8.1	63.2
Orissa	26.1	12.8	61.1
India	30.4	8.7	60.9

Source Jaragan Report, 2001

Poverty

TABLE - 29 : Percentage of people under poverty line (1999-2000)

State	Percentage (%) of people below poverty line
Bihar	***40.9***
Jharkhand	44.0
Chattisgarh	40.5
Uttaranchal	15.2
Punjab	6.2
Maharastra	25.0
Tamil Nadu	21.1
W. Bengal	27.0
Orissa	47.2
India	26.1

Source:NSS 55th round, Bhandari & Dube, 2003

Sanitation

TABLE - 30 : Percentage of families with sanitation facilities, 2001

State	Percentage of families with sanitation facilities
Bihar	***7.9***
Jharkhand	10.7
Chattisgarh	8.9
Uttaranchal	15.4
Punjab	20.4
Maharastra	21.9
Tamil Nadu	23.2
India	18.0

Source: Cencus of India, 2001

Food Security

TABLE - 31 : Percentage (%) of families without food security (1999-2000)

State	Percentage (%) of families without food Security
Bihar	***3.5***
Jharkhand	12.5
Chattisgargh	5.8
Uttaranchal	2.5
Punjab	0.2
Maharastra	1.2
Tamil Nadu	0.7
W. Bengal	8.6
Orissa	7.0
India	2.3

Source: NSS 55th Round

Safe Drinking Water

Percentage of families having safe Drinking Water, 2001

If a family has a supply tap, handpump or a tubewell inside their house or nearby, which they use for drinking water, it is considered that they get safe drinking water. On the basis of data based on census 2001, the following facts may be concluded :

- About 90% of Bihar's population gets safe drinking water.
- The condition of Bihar in availability of safe drinking water is far better than other high ranking states of India.In states like Maharastra, Punjab and Tamil Nadu about 78% of total population gets safe drinking water, whereas in Bihar, the percentage is approx 90%.
- But still, a large number of Bihar's population is dependent on wells for drinking water.

Literacy Rate

In Bihar only 23% students below 10 years of age attend elementary schools. In this respect there is an immediate and urgent need to improve the elementary education system.

TABLE - 32 : Literacy Rate of different States (2001)

State	Literacy Rate
Bihar	***47.5***
Jharkhand	54.1
Chattisgargh	65.2
Uttaranchal	72.3
Maharastra	77.3
Punjab	70.0

Tamil Nadu	73.5
W. Bengal	69.2
Orissa	63.6
India	65.4

Source: Census of India, 2001

The literacy rate of Bihar is the lowest among states and overall as well as national average which is evident from Table - 32.

TABLE - 33 : Ratio of Girls and Boys of Elementary and Secondary Schools of Different States (2001-2002)

State	Ratio of Boys and Girls of Elementary and Secondary Schools
Bihar	0.6
Jharkhand	0.7
Chattisgargh	0.8
Uttaranchal	1.0
Maharastra	0.9
Punjab	0.9
Tamil Nadu	1.0
W. Bengal	0.9
Orissa	0.7
India	0.77

Source: Central Educational Statistisc, 2001-02

The situation of elementary and secondary education system is not very encouraging. The teaching ratio of girls & boys is 10 : 6. It is evident that the admission of girls in comparison to boys is very low. The admission ratio between girls and boys in Bihar is very low comparison to the state

of Jharkhand. In developed states Maharashtra, Punjab and Tamilnadu the ratio of boys and girls is significantly high. Even that in the state of West Bangal ratio is same as that in those of the developed states. On the basis of the facts stated above, the disparity in the gender ratio is evident. Studies have revealed that the admission of large number of girls is reflective of the better quality of education, health and family welfare in future generations.

TABLE - 34 : Ratio (in %) of Student-Teacher in different states

State	Ratio of Student -Teacher
Bihar	***18***
Jharkhand	24
Chattisgargh	31
Uttaranchal	35
Maharastra	22
Punjab	22
Tamil Nadu	15
W. Bengal	31
Orissa	18
India	21

Source: Selected Education Statistic, 2001-02

The low student-teacher ratio is suggestive of the better education imparted to the students, the lesser the number of students attached to a teacher, the better will be the quality of education. While this ratio is 21 at the National level, in Bihar the ratio is that of 18. Here, overall situation of Bihar is better not only in respect of Jharkhand, Punjab, Maharashtra and Tamilnadu but at the National level too.

The data mentioned above indicates quantative education but lacks qualitatively.

Food Production

In state of Bihar 62% of the sowed area is qualitatively irrigated. In comparision to the state of Punjab where the irrigational area is about 94%, the condition needs improvement in Bihar. Due to adequate and timely Monsoon, the lacuna on the irrigational front can be overcome by providing facilities for errecting tanks, lakes and ponds in the probable areas. This will not only enhance the ground water level but also effectively help in irrigational purpose.

TABLE - 35 : Food Production (kg per ha.), 2001-02

State	Food production (Kg per ha.)
Bihar	***1679***
Jharkhand	1094
Chattisgargh	1156
Uttaranchal	1742
Punjab	4040
Maharastra	874
Tamil Nadu	2233
W. Bengal	2424
Orissa	1393
India	1739

Source: Agriculture Ministry, Govt. of India(2001-02)

- In Bihar food production per hectare is low compared to Indian average.
- If we compare developed states like Punjab and Tamil Nadu with Bihar, the situation demands effective interventions for improvement.
- If we compare with neighbouring states like W. Bengal, food production per hectare is high, whereas in Orissa it is low.

TABLE - 36 : Children of 10 yrs who have received Primary education in different states (1999-2000)

State	Children of 10 yrs who have received Primary education (%)
Bihar	22.9
Jharkhand	34.2
Chattisgargh	25.6
Uttaranchal	44.4
Maharastra	46.7
Punjab	38.9
Orissa	31.4
Tamil Nadu	65.4

Source: NSSO, 55th Round

TABLE - 37 : Gross Price

Gross Price (Rs. per person), 2000-01

State	Gross Price (Rs. per person), 2000-01
Jharkhand	1296
Bihar	63
Chattisgargh	396
Uttaranchal	301
Maharastra	1273
Punjab	560
Tamil Nadu	1145
Orissa	246
W. Bengal	296

Source: Annual survey of Industries, 2000-01

TABLE - 38 : Commercial Bank Loan

Commercial Bank Loan per person (Rs.), 2000-01

State	Commercial Bank Loan per person (Rs.)
Jharkhand	122
Bihar	50
Chattisgargh	124
Uttaranchal	194
Maharastra	1369
Punjab	546
Tamil Nadu	654
Orissa	140
W. Bengal	270

Source: RBI 2002, Janaganna 2001

TABLE - 39 : Industrial Labour

Percentage of urban Industrial labour between 15-59 years, 2002

State	Percentage of urban Industrial labour between 15-59 years
Bihar	1.1
Jharkhand	5.4
Chattisgargh	3.5
Uttaranchal	3.0
Maharastra	3.7
Punjab	6.4
Tamil Nadu	6.9
Orissa	2.7
W. Bengal	4.4

Source: Annual Survey of Industries, 2000-01

TABLE - 40 : Houses with T.V

Percentage of Houses with T.V

State	Percentage of Houses with T.V
Bihar	9.1
Jharkhand	17.2
Chattisgargh	21.5
Uttaranchal	42.9
Maharastra	44.1
Punjab	67.7
Tamil Nadu	39.5
W. Bengal	26.6
Orissa	15.5
India	31.6

Source: Janaganna 2001

TABLE - 41 : Basic Infrastructure

Road

Percentage of villages connected with roads, 1999-2001

State	Percentage of villages connected with roads
Bihar	60
Jharkhand	44
Chattisgargh	16
Uttaranchal	62
Maharastra	95
Punjab	92
Tamil Nadu	93
W. Bengal	49
Orissa	41
India	41

Source: Rural Development Ministry, Indian Government, 2001

TABLE - 42 : Length of road per lakh of population in different states, 1999

State	Length of road per lakh of population (km)
Bihar + Jharkhand	81
M.P + Chattisgargh	251
Maharastra	163
Punjab	39.5
Tamil Nadu	266
W. Bengal	246
Orissa	99
India	715

Source : Motor Transport Statistic of India, 1999-2000, Ministry of Road transport and Highways, Indian Government

TABLE - 43 : Density of Post Office

No. of Post Offices per lakh of population in different states, 2000-01

State	No. of P.O. per lakh
Bihar	10.8
Jharkhand	11.3
Chattisgargh	27.8
Uttaranchal	31.8
Maharastra	12.9
Punjab	16.1
Tamil Nadu	19.5
W. Bengal	22.2
Orissa	10.8
India	15.1

Source : Book of Information 200-01, Department of Posters, Ministry of communication, Janaganna, 2001

TABLE - 44 : Density of Telephone

No. of telephones per 100 people in different states

State	No. of telephones per 100 people
Bihar	1.3
Jharkhand	1.5
Chattisgargh	1.4
Uttaranchal	3.4
Maharastra	10.4
Punjab	10.6
Tamil Nadu	8
W. Bengal	2.9
Orissa	2.1
India	4.9

Source: indiastate.com(2001-02)

TABLE - 45 : Commercial Market

Bank deposit per person in different states

State	Deposit in all commercial banks/person (in Rs.)
Bihar	2354
Jharkhand	4866
Chattisgargh	2823
Uttaranchal	8188
Maharastra	14802
Punjab	13062
Tamil Nadu	7658
W. Bengal	5874
Orissa	3105

Source: RBI 2001, figures in Rupees.

TABLE - 46 : Two wheeler & four wheeler

Percentage of people with two wheeler & four wheeler in different states, 2001

State	% of families with Four wheeler	% of families with Two wheeler (apart from cycle)
Bihar	0.9	3.6
Jharkhand	1.5	9.3
Chattisgargh	1.4	10.8
Uttaranchal	2.7	11.9
Maharastra	3.4	13.2
Punjab	5.8	31.6
Tamil Nadu	2.2	16.1
W. Bengal	1.9	5.0
Orissa	1.1	*7.9*

Source: Janaganna, 2001

TABLE - 47 : Rich houses in numbers

Percentage of rich families of urban & rural areas in different states

State	% of rich families in rural areas	% of rich families in urban areas
Bihar	9.8	13.9
Jharkhand	9.8	18.6
Chattisgargh	9.6	16.3
Uttaranchal	36.1	24.3
Maharastra	26.8	36.0
Punjab	59.6	28.5
Tamil Nadu	26.8	26.8
W. Bengal	18.6	27.3
Orissa	10.7	12.6

Source: NNSO 55th Round, 1999-2000

TABLE - 48 : Health

Infant Mortality Rate per thousand live births

State	Infant Mortality	Male to female death ratio
Bihar	62	0.8
Jharkhand	62	0.7
Chattisgargh	77	0.9
Uttaranchal	48	1.0
Maharastra	45	0.9
Punjab	52	0.7
Tamil Nadu	49	0.8
W. Bengal	51	1.1
Orissa	91	1.0
India	66	0.9

Source: NRS Bulletin, 2003

TABLE - 49 : Delivery through trained person

Percentage of delivery through trained person(1998-99)

State	Percentage of delivery through trained person
Bihar	25.1
Jharkhand	17.8
Chattisgargh	32.4
Uttaranchal	35.1
Maharastra	59.4
Punjab	62.6
Tamil Nadu	83.8
W. Bengal	44.4
Orissa	33.5
India	42.3

Source: National Family Health service, 1998-99

TABLE - 50 : Expected Mortality rate

Percentage of expected mortality rate in different states, 2002

State	Mortality rate
Bihar	7.9
Jharkhand	7.9
Chattisgargh	8.7
Uttaranchal	6.4
Maharastra	7.3
Punjab	7.1
Tamil Nadu	7.7
W. Bengal	6.6
Orissa	9.8
India	8.1

Source: SRS, Bulletin 2003 Registrar general of India

TABLE - 51 : Commercial Loans

Revenue receipt per person

Revenue receipt per person (In Rs.) in different states

State	1990-91	1995-96	2000-01	2001-02
Bihar	500	793	1139	1231
Jharkhand	-	-	-	2264
U.P	597	971	1454	1540
Tamil Nadu	911	1783	2965	3015

Source: Handbook of Statistic on State Government Finance, 2004

TABLE - 52 : Revenue expenditure per person

Revenue expenditure per person (In Rs.) in different states

State	1990-91	1995-96	2000-01	2001-02
Bihar	566	909	1435	1516
Jharkhand	-	-	-	2229
U.P	686	1120	1823	1914
Tamil Nadu	1010	1835	3521	3471

Source: Handbook of Statistic on State Government Finance, 2004

TABLE - 53 : Financial Investment of State Governments

Financial Investment of State Governments per person (In Rs.) in different states.

State	1990-91	1995-96	2000-01	2001-02
Bihar	154	103	260	279
Jharkhand	-	-	-	719
U.P	194	206	332	381
Tamil Nadu	175	273	435	525

Source: Handbook of Statistic on State Government Finance, 2004

TABLE - 54 : Expenditure on Social Services

Expenditure on Social Services (In %)

State	1990-91	1995-96	2000-01	2001-02
Bihar	39.3	38.4	40.6	35.3
Jharkhand	-	-	-	40.9
U.P	35.6	31.3	29.7	29.4
Tamil Nadu	44.2	39.7	35.8	35.6

Source: Handbook of Statistic on State Government Finance, 2004

TABLE - 55 : Transfer of resource from Central Government

Support from Central Government (per 10 lakh person)

State	1990-91	1995-96	2000-01	2001-02
Bihar	9.3	10.8	10.7	15.0
Jharkhand	-	-	-	32.3
U.P	14.8	14.8	16.3	19.8
Tamil Nadu	10.4	13.2	13.2	22.1

Source: Handbook of Statistic on State Government Finance, 2004

TABLE - 56 : Per person gross financial loss

Financial loss (Rs. per person) 2001-02

State	Financial loss (Rs. per person)
Bihar	484
Jharkhand	610
Chattisgargh	510
Uttaranchal	500
Maharastra	1126
Punjab	2041
Tamil Nadu	763
Orissa	1080
W. Bengal	1471
India	940

Source: Handbook of Statistic on State Government Finance, 2004

3.2. ENVIRONMENTAL RESOURCES :

3.2.1. BROWN AGENDA :

3.2.1.1. Air Quality :

Data on the ambient air quality over Patna are given in the table - 14 to 23 and 57 to 59. Wind direction data for different months of the year was obtained and a wind rose diagram was prepared. The data on air quality included the parameters of SPM (Suspended Particulate Matter), SO_2 & NO_X ($NO + NO_2$). The monthly mean values of these parameters indicating the level of air pollution was plotted for the years 1991-94. The Monitoring station was Beltron Bhawan, Bailey Road, where the dominant land-use is public/semi public buildings (residential complex with garden), Zoological Garden and airport under overall category of built up land.

TABLE - 57

The National Ambient Air Quality Standareds set by

Central Pollution Control Board

Zone	SPM ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	CO ($\mu g/m^3$)
Industrial mixed	500	120	120	5000
Residential & Rural Use	200	80	80	2000
Sensitive Zones (Sancturies, National Park, Health Resort)	100	30	30	1000

TABLE - 58

Ambient air quality data over Patna at Beltron Bhawan for the year 1990-94

Year	Month	SPM (µg/m^3)	SO_2 (µg/m^3)	NO_x (µg/m^3)
1	2	3	4	5
1990	May	272	NA	Na
	June	295.9	NA	NA
	July	167		
	Oct.	220.9	07.46	33.74
	Dec.	231.3	11.62	37.69
1991	Jan	257.83	8.85	38.53
	Feb.	296.56	13.24	31.92
	March	281.09	15.87	29.58
	April	252.82	17.13	23.67
	May	342.92	12.05	22.17
	June	276.0	5.88	8.34
	July	219	3.31	11.31
	Aug.	220.99	20.29	26.36
	Sept.	195.1	15.24	20.63
	Oct.	NA	–	–
	Nov.	189.26	13.94	22.40
	Dec.	200	15.87	24.30
1992	Jan.	231.67	17.11	29.66
	Feb.	235.76	17.70	29.31
	March	247.55	18.05	30.05
	April	235.70	14.51	24.12
	May	307.79	16.89	26.24
	June	348.78	18.48	22.15

1	2	3	4	5
	July	225.23	7.53	11.08
	Aug.	153.95	11.98	19.72
	Sept.	178.78	13.86	21.38
	Oct.	277.15	14.67	18.68
	Nov.	336.00	13.7	16.9
	Dec.	546	14.1	30.77
1993	Jan.	387	8.1	13.9
	Feb.	504	9.3	14.4
	March	438	8.4	12.8
	April	392	8.0	12.5
	May	458	9.9	14.5
	June	247	08.0	13.0
	July	104.61	11.31	14.47
	Aug.	90.98	8.71	16.10
	Sept.	64.00	6.3	13.1
	Oct.	131	11.5	18.3
	Nov.	161	17.7	17.9
	Dec.	343.5	21.1	28.5
1994	Jan.	242	15.9	21.9
	Feb.	277	15.6	21.3
	March	231	15.4	21.4
	April	313	14.0	19.3
	May	292	11.4	20.4
	June	194	09.3	16.2
	July	101	7.1	20.8
	Aug.	97.4	7.78	27.23
	Sept.	161.87	13.15	35.33
	Oct.	227.87	9.09	26.27
	Nov.	214.12	12.11	31.85
	Dec.			

TABLE - 59

Station	Month	SO_2 (µg/m³)	NO_x (µg/m³)
N.G.Road	Nov., 1990	27.80	37.24
Hospital	Dec., 1990	27.10	37.66
	Jan., 1991	28.17	39.36
Boring Canal	Nov., 1990	38	30.72
Road Crossing			

The NO_x and SO_2 level in the air over the given category of landuse is well within the prescribed limits and there is nothing critical in this regard. The content of NO_x & SO_2 in the air show distinct monthly variation. The ambient air of Patna has higher values of NO_x & SO_2 (peaks) in the post-monsoon to winter months (Oct. - Feb.) and lowest during monsoon season (July-sept.). This obviously explains the role of rainfall in lowering the content of these gases. Of the two gases, the NO_x content is higher than SO_2 and remains so for the whole year.

The bulk of SO_2 in air over Patna is due to the plying of automobile on congested roads, as there are few industries in the city that could be held accountable for contribution of SO_2 . This gas is also contributed through the burning of coal as domestic fuel being used by a sizeable chunk of the urban population. NO_x is contributed through both, exhausts of the automobiles as well as the plant cover in the city.

For control of automobile exhaust, State Transport Department, GoB has authorised 82 Emission Test Centres as on March, 2006.

The role of vegetal cover in this regard is exemplified by NO_x values recorded at PMCH, Boring Canal Road crossing, New Gardiner Road Hospital and Beltron Bhawan in Oct. - Dec., 1990. Of the places mentioned above, PMCH area has got almost negligible vegetal cover while Beltron Bhawan & New Gardiner Road Hospital areas have got higher vegetal cover. The impact of automobile exhausts on NO_x content is also clearly

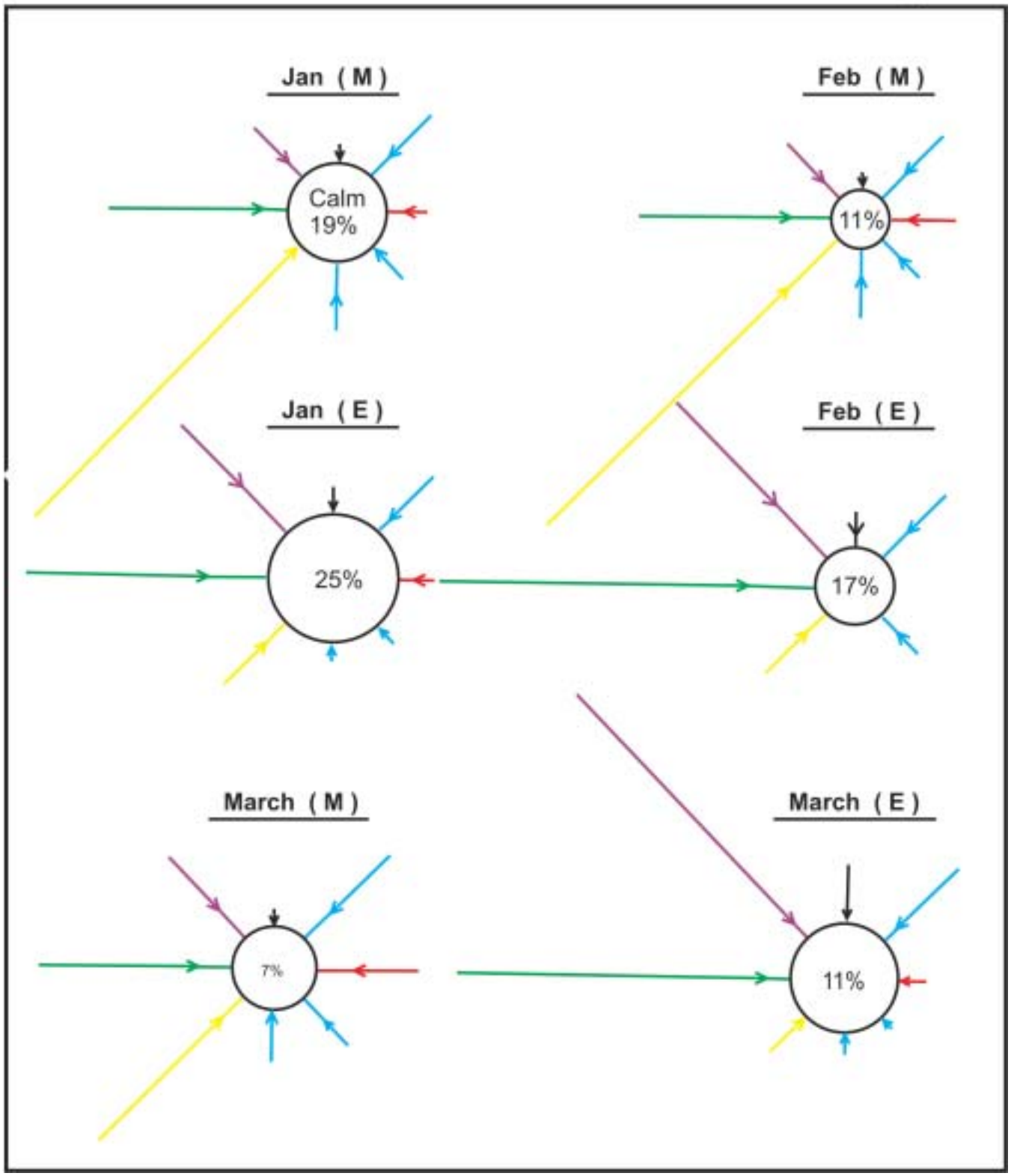
demonstrated by the comparison of air data recorded at aforesaid stations. The traffic density at Boring Canal Road crossing & N.G. Road Hospital is higher than that at Beltron Bhawan. One month observation (Oct., 1990) at PMCH is available. This hospital is located in the dense built up land category of the land use of Patna where the traffic density is high and traffic congestion is also high. At this place the value of SO_2 is higher than the other observation stations referred above for the same month of the same year. Though the average SO_2 & NO_x content at PMCH is below the tolerance limit, its maximum values exceed the specified tolerance limits (30 µg/m^3) and hence the traffic congestion is hazardous for the hospital patients.

The SPM value is by and large above the tolerance limits for a very large part of the city. The principal sources of SPM are the automobile exhausts, road dust, exhausts of D.G. sets, industrial units at patliputra & the large channel/sandbars of the Ganga & the Sone, burning of coal by roadside tea shops and hotels, and burning of dry leaves garbage etc. The SPM value remain high (over 230 µg/m^3) between January to June and fall below 200/µg/m^3 range between July to September and again start rising from October onward.

A perusal of rose diagrams showing monthly wind direction pattern & calm days with the monthly variation Graph (Fig. 3, 4, 5 & 6)enclosed herewith distinctly establishes one of the principal sources for SPM to be the sands from the river Ganga & Son which are to the north, west & southwest of the city. During the rainy months of July, August and Sept. the dominant wind direction is from east, northeast & southeast and the river channels during this period have by and large submerged channel bars. The dominant prevailing wind direction in the months are from west, northwest, southwest, northeast & east. The dry river beds thus become source of SPM during these months. Boring Canal Road crossing in November, 1990 showed an abnormal high of 1213 µg/m^3 SPM and this certainly can be attributed to high automobile traffic density along with contributions from channel bars of the Son and the Ganga. The SPM value in PMCH is well above the tolerance limit. The air quality observations at three localities in the campus of PMCH is given in Table - 52

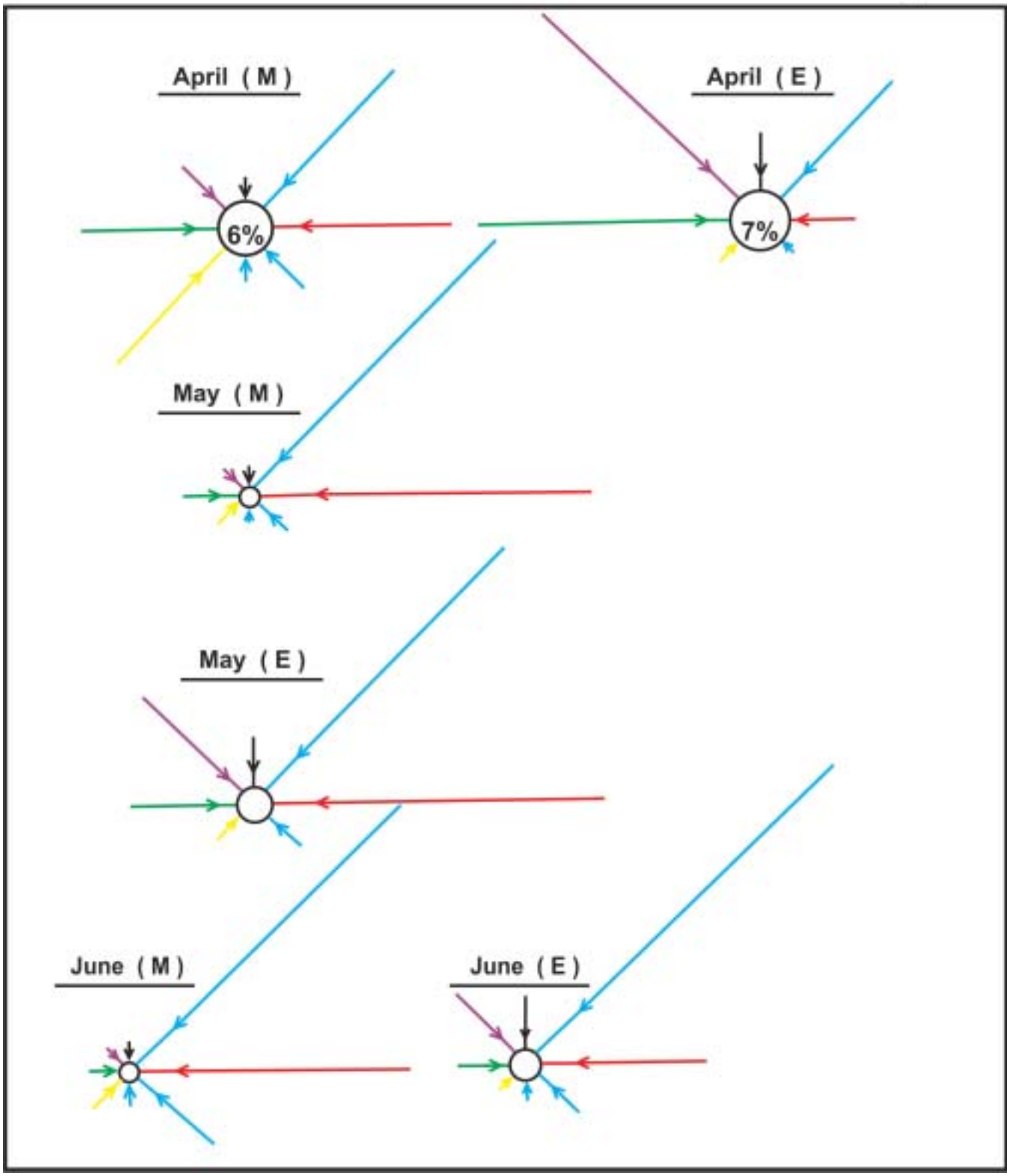
MEAN MONTHLY WIND DIRECTION

Fig. – 3



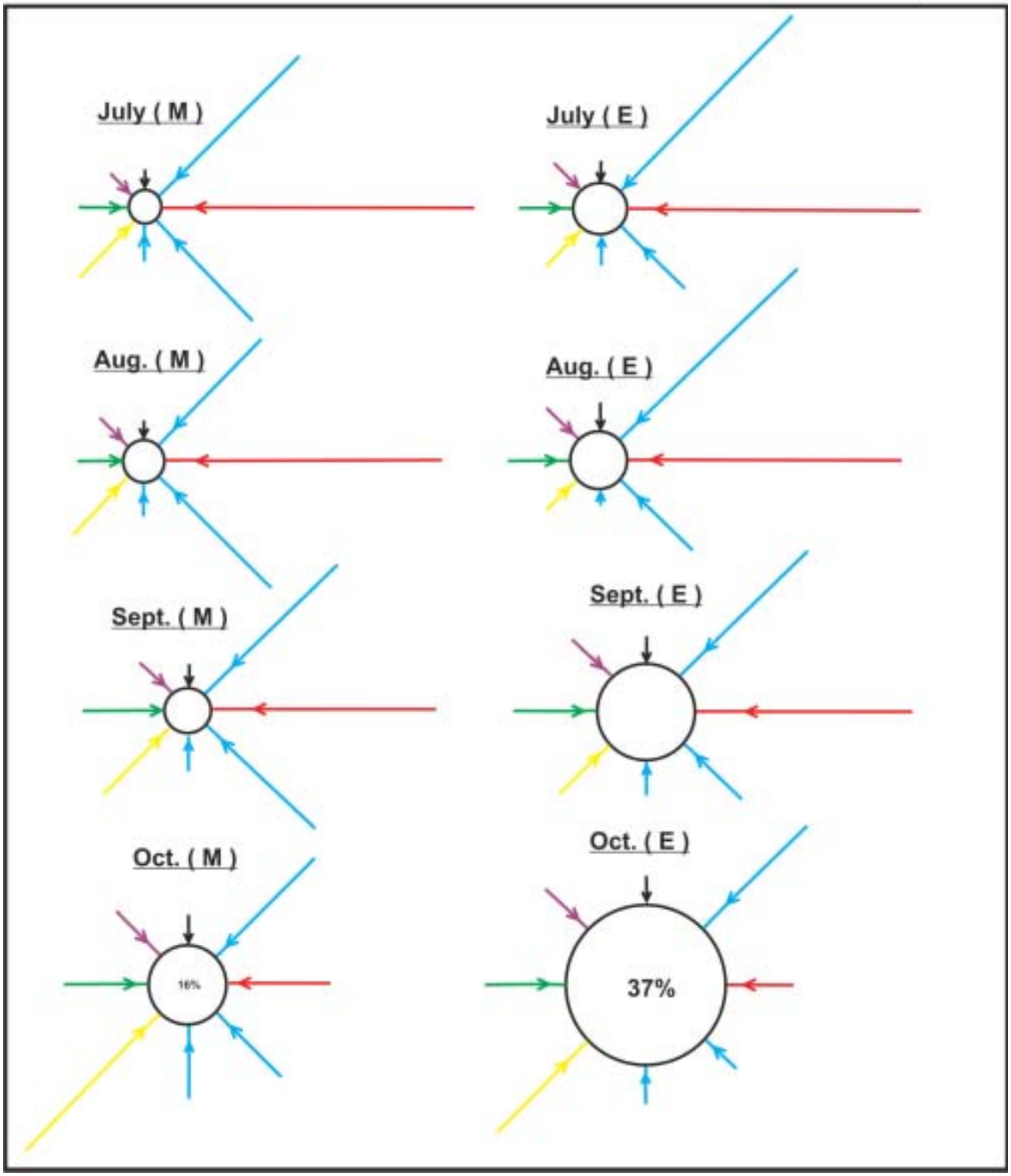
MEAN MONTHLY WIND DIRECTION

Fig. – 4



MEAN MONTHLY WIND DIRECTION

Fig. – 5



MEAN MONTHLY WIND DIRECTION

Fig. – 6

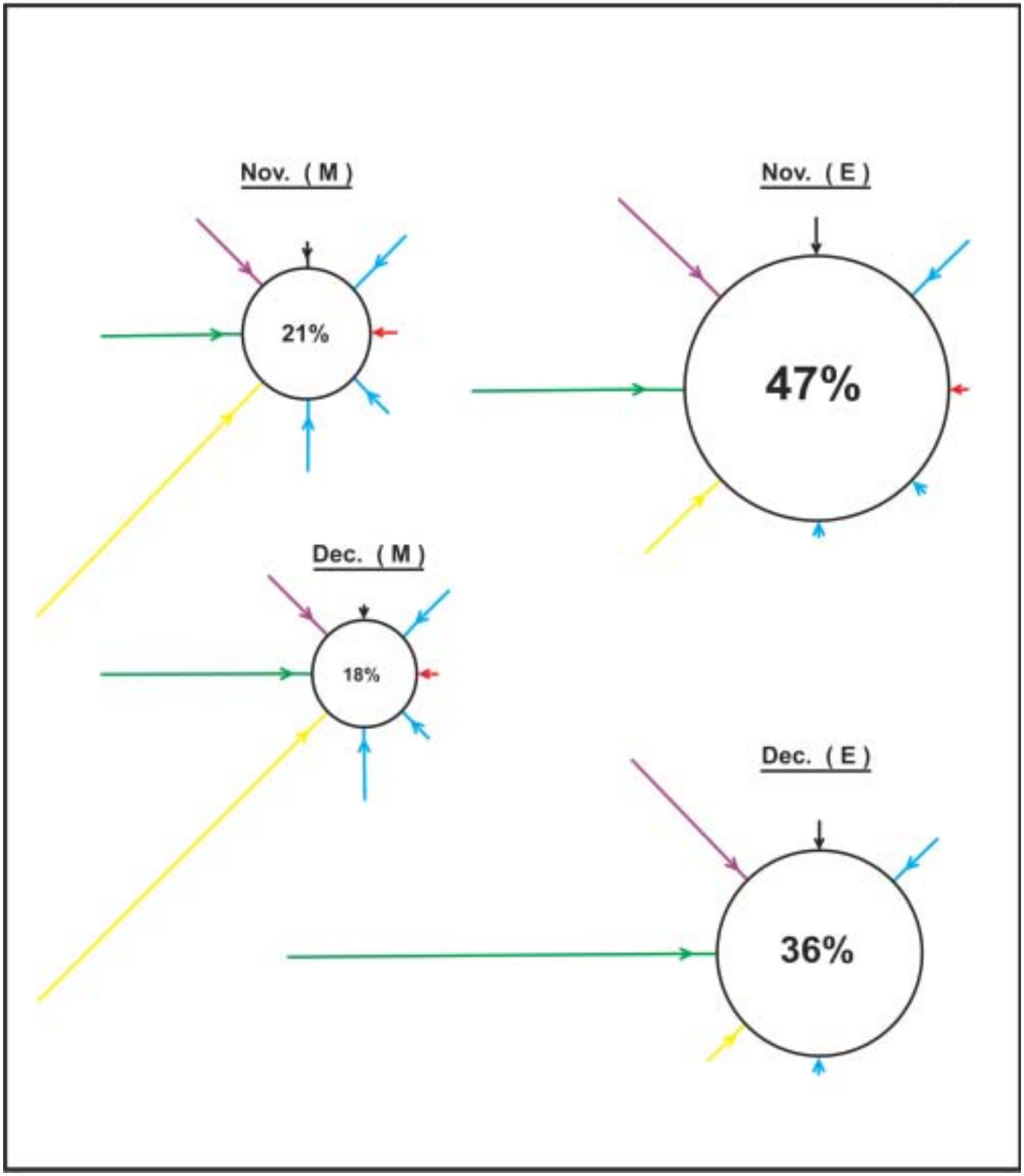


TABLE - 60

Air quality data in PMCH campus

Sampling Point	SMP (µg/m^3)	SO_2 (µg/m^3)	NO_x (µg/m^3)
Nearly 33 m from the southern bank of the Ganga & 33 m north of Ashok Raj Path, 3 m a.g.l.	24 hourly values are 399.53 Min. 324.5 max 547.8 Tolerance limit 100	24 hourly min. 21.93 Max. 34.76 Tolerance limit 30	Min. 1.32 Max. 12.64 Tolerance limit 30
Administrative Block in the middle of campus.	Min. 250.75 Max. 406.6	Min. 0.86 Max. 24.32 Ave. 9.11	Min. 6.35 Max. 22.86 Ave. 12.31
Eastern part of PMCH campus, 25 m south of southern bank of the Ganga	Max. 581.63 Min. 221.14 Ave. 455.10	Max. 30.34 Min. 0.88 Ave. 13.34	Max. 30.34 Min. 17.36 Ave. 24.23

3.2.1.2. SEWAGE

Urbanisation is inherently linked with consumption of natural and manmade resources and hence generation of solid, liquid and gaseous waste is a continuous and increasing process. The discussion is confined to liquid and solid waste generation and a brief account of its management.

Solid waste can be categorised into the following three types- (1) Municipal solid waste, (2) commercial, industrial and construction demolition waste and (3) Street refuge. The average solid waste generated in an Indian city is 0.33 kg/capita/day while the range in Patna is 0.15 kg/capita/day to 0.38 kg/capita day. Assuming a popoulation of 15,00,000

this city generates about 0.33 × 15,00,000 = 4,95,000 Kg solid waste per day. Atleast 50% of this is arenaceous and argillaceous material and rest are decomposable vegetable matter, papers, metal pieces, glass and human and animal excreta etc. The waste is dumped at various topographic low sites in the city, particularly in the southern and eastern part characterised by wet land.

The liquid waste is sewage and sullage which flows through a network of open and underground sewer lines into the Ganga and the Punpun. Prior to 1936 the liquid waste of the city used to flow directly into the Ganga through open drains (Out falls) at Kurji, Rajapur, Mandiri, Antaghat, Krishnaghat & Mote. But in 1936 a sewage treatment plant at Saidpur in Central Zone was built with a capacity to treat 2 MLD sewage and a small STP at Beur (Western Zone) was built in 1975 to treat the liquid waste before releasing the same into the Ganga.

With the growth of urban area and consequent activities there was a need to strengthen the existing STPs, increase the network of soil sewage lines and storm water drains. By late 80s, three STPs came into existence to treat the sewage and use of treated sewage in irrigation.

The following information is available about various STPs.

1. Central Zone with STP at Saidpur has present capacity to handle 45 MLD raw sewage by Activated Sludge Process. The treated sewage flows through Rampur drains into Barmutta Nala and finally may lead to the Punpun.

2. Western Zone with STP at Beur has present capacity of 35 MLD raw sewage to be treated by Activated Sludge Process.

3. Southern Zone with STP at Pahari has an installed capacity to handle 25 MLD raw sewage by Activated Lagoon System. The treated sewage flows into the Punpun

through Barmutta nala.

4. Karmalichak STP for Eastern Zone with capacity of 4 MLD by Oxidation Pond Method is in the process of installation.

Sewage Chemistry

The chemical aspect of raw sewage and treated sewage at Saidpur STP is available for 1995-96 (Figure - 12). The analysis of data include pH, DO, TSS, TSVS, BOD and COD. The averge pH of raw sewage range from 7.13-7.25 and that of treated sewage range from 7.4-7.29. Average BOD range from 147-185 mg/ltr. While the same for treated sewage varies from 12-30 mg/lter. Average Disolved Oxygen of untreated sewage is close to 0.5 mg/L and treated sewage 2.81-4.0 mg/L.

The pH of raw sewage remains near neutral to alkaline (below 8) but between July - Dec., 1993 & 1996 a feeble rise in pH was observed indicating a rise in alkalinity. The sewage becomes slightly more alkaline in wetter months.

Between July - Dec., 1993, 1995 & 1996 there is a rise in COD. The same was observed between January - March of 1994 & 1996. The DO of the treated sewage remained below the optimum level of 5 mg/L. The COD of treated sewage at Saidpur hovers around 45-60 mg/L but after flowing through open drains which is fed by sludge & municipal refuge of dense urban population of East and Central Patna it again rises close to 450 mg/L near Agamkuan which is joined by another drain from Pahari.

TABLE - 61

S.T.P. Pahari Patna
(Final Effluent)

S.N.	Date of Collection	Temp A/W	pH mg/L	D.O. mg/L	BOD mg/L	COD mg/L	T.S. mg/L	TSS mg/L	Cl mg/L
1.	9-4-2003	38/28	9.94	24.6	26	176	864	430	48
2.	28-5-2003	36/30	8.7	15.4	30	140	1126	488	60
3.	14-7-2003	37/32	8.62	13.6	38	144	1024	38	51
4.	28-8-2003	32/28	7.16	10.8	24	80	802	104	37
5.	23-9-2003	32/28	9.42	19.6	26	88	708	96	36
6.	12-1-2004	16829	8.71	14	44	176	892	154	42
7.	12-6-2004	37/30	7.82	3.2	40	88	1442	144	50
8.	20-12-2004	18/18	8.8	10.6	45	88	986	184	54
9.	10-5-2005	40/23	8.48	-	32	80	1108	140	48
	Limit				**20**			**30**	

TABLE - 62

S.T.P. Saidpur Patna
(Final Effluent)

S.N.	Date of Collection	Temp A/W	pH mg/L	D.O. mg/L	BOD mg/L	COD mg/L	T.S. mg/L	TSS mg/L	Cl mg/L
1.	9-4-2003	35/30	8.7	2.6	5.0	48.0	722	130	54
2.	28-5-2003	39/30	8.0	3.1	42	160	8.32	124	60
3.	14-7-2003	32/31	7.8	2.5	35	140	826	84	56
4.	28-8-2003	32/26	7.41	2.8	12	60	906	130	54
5.	23-9-2003	30/29	7.5	3.8	15	56	1934	84	54
6.	12-1-2004	14/21	7.46	2.8	32	180	1016	108	50
7.	10-2-2004	23/22	7.53	3.1	15	56	986	92	61
8.	12-6-2004	40/32	8.21	2.4	56	108	748	44	59
9.	10-7-2004	31/3	7.64	3.2	8.8	28	720	176	59
10.	20-12-2004	20/22	7.9	3.8	25.0	48	1126	1230	58
11.	10-5-2005	37/25	7.84	-	20	52	1010	130	56
	Limit				**20**			**30**	

TABLE - 63

S.T.P. Beur Patna
(Final Effluent)

S.N.	Date of Collection	Temp A/W	pH mg/L	D.O. mg/L	BOD mg/L	COD mg/L	T.S. mg/L	TSS mg/L	Cl mg/L
1.	9-4-2003	38/28	9.94	1.0	4.5	40	1304	266	54
2.	28-5-2003	42/32	7.8	2.8	20	80	1296	218	60
3.	14-7-2003	33/30	7.38	2.0	14	60	928	56	49
4.	28-8-2003	34/29	7.42	0.8	18	80	838	236	40
5.	23-9-2003	33/28	7.6	2.8	12	52	1068	72	44
6.	12-1-2004	15/20	7.48	3.0	48	188	846	1444	50
7.	10-2-2004	19/18	7.43	-	25	80	918	126	53
8.	25-6-2004	37/30	7.54	2.0	26	64	968	116	56
9.	20-12-2004	17/18	7.7	3.4	42	84	1028	158	56
10.	10-5-2005	40/23	7.71	-	32	84	936	134	58
	Limit				**20**			**30**	

TABLE - 64

S.T.P. Bhagalpur
(Final Effluent)

S.N.	Date of Collection	Temp A/W	pH mg/L	D.O. mg/L	BOD mg/L	COD mg/L	T.S. mg/L	TSS mg/L	Cl mg/L
1.	17-6-2003	32/28	8.5	-	6.0	24	1346	140	230
2.	27-4-2005	37/26	7.61	-	35	112	1046	134	278

TABLE - 65

S.T.P. Beur Patna
(Raw Effluent)

S.N.	Date of Collection	Temp A/W	pH mg/L	D.O. mg/L	BOD mg/L	COD mg/L	T.S. mg/L	TSS mg/L	Cl mg/L
1.	28-8-2003	34/28	7.18	-	130	240	2468	404	42
2.	29-9-2003	33/27	7.33	-	52	112	2330	408	33
3.	12-1-2004	15/22	7.28	-	42	160	2384	160	48
4.	10-2-2004	19/18	7.08	-	215	856	3268	632	74
5.	25-6-2004	34/31	7.14	0.1	150	224	2420	230	65
6.	20-12-2004	17/18	7.8	-	130	252	2088	436	60
7.	10-5-2005	40/24	7.53	-	140	260	2008	332	63

TABLE - 66

S.T.P. Pahari Patna
(Raw Effluent)

S.N.	Date of Collection	Temp A/W	pH mg/L	D.O. mg/L	BOD mg/L	COD mg/L	T.S. mg/L	TSS mg/L	Cl mg/L
1.	28-8-2003	33/29	7.52	-	65	120	1086	282	12
2.	23-9-2003	32/27	7.4	-	75	136	1324	82	27
3.	12-1-2004	16/20	7.41	-	74	284	1894	204	35
4.	12-6-2004	36/32	7.52	1.0	90	192	486	102	20
5.	20-12-2004	18/19	7.83	-	115	224	1734	226	50
6.	10-5-2005	39/24	7.42	-	46	116	1684	202	50

TABLE - 67

S.T.P. Saidpur Patna
(Raw Effluent)

S.N.	Date of Collection	Temp A/W	pH mg/L	D.O. mg/L	BOD mg/L	COD mg/L	T.S. mg/L	TSS mg/L	Cl mg/L
1.	28-8-2003	32/26	7.28	-	120	224	2044	386	56
2.	23-9-2003	30/28	7.4	-	90	192	2450	264	52
3.	12-1-2004	14/20	7.21	-	50	196	2348	282	48
4.	10-2-2004	23/21	7.02	3.1	45	184	2210	266	59
5.	10-7-2004	30/30	7.5	-	120	224	1128	266	58
6.	20-12-2005	20/21	7.0	-	120	244	2628	308	54
7.	10-5-2005	37/22	7.57		68	172	1986	234	66

TABLE - 68

S.T.P. Bhagalpur
(Raw Effluent)

S.N.	Date of Collection	Temp A/W	pH mg/L	D.O. mg/L	BOD mg/L	COD mg/L	T.S. mg/L	TSS mg/L	Cl mg/L
1.	17-6-2003	30/27	8.0	-	140	320	1676	160	220

3.2.2. GREEN AGENDA

3.2.2.1 FOREST

Vegetation - After the bifurcation of the state only 7% of the forest remains in Bihar. Earlier Bihar had 17.3% forest cover. The population pressure is main cause of loss of forest cover. The farming is the main occupation of the plain. Bihar is rich in biodiversity and the flood plains are potential areas of forest cover. Broadly, Bihar has monsoon type of forest, therefore, forest cover in Bihar can be divided into three major heads:

1. Dry deciduous Forest
2. Wet deciduous Forest, and
3. Sub Himalayan and Tarai Forest

1. Dry deciduous forest- This type of forest is found in N.E region of Kishanganj district and particularly in the water logged area. Someshwar hill area of the Kishanganj has also this type of forest. There is very high density of forest. The major vegetation type is Sal. Apart from Sal, Assan, Semal, Ghaura, Caham, Kend, Mango, Jamun are the major vegetation cover. Here the annual rainfall is more than 120 cm.

2. Wet deciduous forest- This type of forest is found in those areas where the annual rainfall is less than 120 cm. They are not dense forest. The trees are widely spread. In presence of clear sunlight, the area is suitable for farming. The average height of trees are low. The region is also categorised in the open forest. This type of vegetation is found in hills of Kanpur and north eastern slopes of Chotanagpur plateau. They are also found in Rauxal, Purnia and Araria districts. The major vegetation type is Sal, Bamboo, Khair, Pal, Shesham, Mahua and Kend. Bushes of Bair & Kenvad are also found.

3. Sub Himalayan and Tarai forest- Northern part of Bihar and boarder of Nepal are full of this type of forest. The major area in which this type of forest are found are

western Champaran (Showmeshwar), Purnia and Araria. Here there are high humidity and low temperature due to height. The major vegetation type are sal, Tun, Oak, Pinl. This area is sample evidence of the type of vegetation found in Sub Himalayan forest. Small bushes like Sawana grass, bamboo, Merkat and Jhau are found in the southern part.

The growing demand of wood in the day-today life and in paper industries, the government has launched comprehensive plan for plantation. Plantation of Bamboo, Eucalyptus and Teak are top in the agenda. In order to protect wild life, the government has notified reserved area. They are as follows:

1. Bhimbhand, Munger (Tiger, Tendua, Chital, Banaur saver, Nilgai)
2. Rajgir, Rajgir (Kokar, Langoor, Deer, Nilgai, Cheeta)
3. Valimikinagar Project Tiger, Champaran (water birds, Cheetal, Tiger, Tendua, Crochodile, Para, Mrig, Baneur saver)
4. Gautam Budh, Gaya (Tiger, Cheeta, Samber, Cheetal, Nilgaya, Beneur saver)
5. Kaiwar Jheel bird, Begusarai (various types Indian and migratory birds)
6. Kusesar, Darbhanga (Siberian birds)
7. Gogavilla, Katihar
8. Perman Dolphin

Bihar needs 33% forest cover. Tarai belt, Southern plateau and river banks are potential areas of forest. But the major problem in Bihar is river erosion. The social forestry has also wider scope in Bihar. Large area of the flood plain is ideally suitable for forest. Therefore, these area may be utilized for forest. The government has launched a programme to plant trees along the roadside, open railway land and on barren land. The scope of these forest is to meet the requirement of fossil fuel, fodder etc. Forest farming is also being practised in Bihar. Farmers are encouraged to plant trees of Sal, Shesam, etc. in their repective barren land.

Due to low forest cover, the state is facing acute problem of rainfall, soil erosion, low size of pure sowing land and above all decreasing wild life animals. The population of wild life animal is shrinking at a phenomenal rate. Earlier, Gaya, Nawada, Munger, Jamui, Sasaram, Kaimur, Purnia, Araria, Champaran, Darbhanga districts were having sufficient forest cover but at present these districts are almost devoid of forest cover. Districtwise forest cover is shown in Table- 69. This has also resulted in air pollution. Therefore, there is an immediate and urgent need to check deforestation and give thrust on plantation.

TABLE - 69

Districtwise Forest Cover (Area in Sq.km)

District	Geographic Area	Forest Cover: Very Dense	Moderately Dense	Open Forest	Total Forest	Percent
Araria	2830	0	14	14	28	0.99
Aurangabad	3305	0	46	100	146	4.42
Banka	3022	0	120	91	211	6.98
Begusarai	1918	0	3	3	6	0.31
Bhabhua	3381	0	544	550	1094	32.36
Bhagalpur	2567	0	12	7	19	0.74
Bhojpur	2390	0	7	1	8	0.33
Buxar	1708	0	8	4	12	0.70
Darbhanga	2279	0	5	6	11	0.48
Gaya	4976	0	119	463	582	11.70
Gopalganj	2033	0	0	0	0	0.00
Jamui	3107	9	392	256	657	21.15
Jehanabad & Arwal	1569	0	2	1	3	0.19
Katihar	3057	0	1	4	5	0.16
Khagaria	1486	0	2	1	3	0.20
Kishanganj	1884	0	1	8	9	0.48
Lakhisarai	1356	0	176	18	194	14.31
Madhepura	1788	0	6	4	10	0.56
Madhubani	3501	0	10	4	14	0.40
Munger	1347	43	201	18	262	19.45
Muzaffarpur	3172	0	2	2	4	0.13
Nalanda	2367	0	16	47	63	2.66
Nawada	2494	0	191	316	507	20.33
Pashchimi Champaran	5228	24	694	201	919	17.58
Patna	3202	0	7	8	15	0.47
Purvi Champaran	3968	0	9	1	10	0.25
Purnia	3229	0	4	11	15	0.46
Rohtas	3832	0	310	374	684	17.85
Saharsa	1680	0	5	1	6	0.36
Samastipur	2904	0	9	3	12	0.41
Saran	2641	0	7	4	11	0.42
Sheikhpura	612	0	1	0	1	0.16
Sheohar	572	0	1	0	1	0.17
Sitamarhi	2071	0	4	1	5	0.24
Siwan	2219	0	1	3	4	0.18
Supaul	2432	0	9	6	15	0.62
Vaishali	2036	0	12	0	12	0.59
Total	94,163	76	2,951	2,531	5,558	5.90

(Source: State of Forest Report, 2003)

3.2.2.2. BIODIVERSITY

Flora of Bihar

Erstwhile Bihar, lying close to the foot hills of Nepal and covering an area of 1,73,877 sq km, harbours a very rich and diverse flora. Its unique phytogeographical position, topography and good precipitation are some of the important factors which are mainly responsible for high degree of plant diversity. The occurrence of different types of forests, ranging from subtropical to tropical and consequently the establishment of three National Parks and twenty Wildlife sanctuaries in the state, which constitute an important source of germplasm, are of considerable interest. Although the state has been botanically surveyed since 1848 and the Flora was published during 1921-1925 which included Bihar, Orissa and parts of West Bengal, but the complete Flora of Bihar itself is not in hand. Simultaneously, the natural vegetation since Haines' publication has been continuously and increasingly under pressure owing to developmental projects including mining activities and non-judicious exploitation of plant resources. These reasons coupled with the publication of a number of new plant records for the state warrant the need of fresh estimation of current status of floristic account of the state.

The major families found in the areas are as follows:

1. Ranunculaceae. 2. Dilleniaceae. 3. Magnoliaceae. 4. Annonaceae. 5. Menispermaceae. 6. Berberidaceae. 7. Nymphaeaceae. 8. Nelumbonaceae. 9. Papaveraceae. 10. Fumariaceae.11.Brassicaceae. 12. Capparaceae. 13. Violaceae. 14. Bixaceae. 15. Cochlospermaceae. 16. Flacourtiaceae. 17. Pittosporaceae. 18. Polygalaceae. 19. Caryophyllaceae. 20. Portulacaceae. 21. Tamaricaceae. 22. Elatinaceae. 23. Hypericaceae. 24. Clusiaceae. 25. Theaceae. 26. Dipterocarpaceae. 27. Malvaceae. 28. Bombacaceae. 29. Sterculiaceae. 30. Tiliaceae. 31. Elaeocarpaceae. 32. Linaceae. 33. Erythroxylaceae. 34. Malpighiaceae. 35. Zygophyllaceae. 36. Geraniaceae. 37. Tropaeolaceae. 38. Oxalidaceae. 39. Averrhoaceae. 40. Balsaminaceae. 41. Rutaceae. 42. Simaroubaceae. 43. Balanitaceae. 44. Ochnaceae. 45. Burseraceae. 46. Meliaceae. 47. Olacaceae. 48. Opiliaceae. 49. Icacinaceae. 50. Aquifoliaceae. 51. Celastraceae. 52. Siphonodontaceae. 53. Hippocrateaceae. 54. Rhamnaceae. 55. Vitaceae. 56. Leeaceae. 57. Sapindaceae. 58. Sabiaceae. 59. Anacardiaceae. 60. Moringaceae. 61. Fabaceae. 62. Caesalpiniaceae. 63. Mimosaceae. 64. Rosaceae. 65. Vahliaceae. 66. Crassulaceae. 67. Droseraceae. 68. Haloragidaceae. 69. Callitrichaceae. 70. Rhizophoraceae. 71. Combretaceae. 72. Myrtaceae. 73. Lecythidaceae. 74. Melastomataceae. 75. Lythraceae. 76. Punicaceae. 77. Onagraceae. 78. Trapaceae. 79. Turneraceae. 80. Passifloraceae. 81. Caricaceae. 82. Cucurbitaceae. 83. Begoniaceae. 84. Cactaceae. 85. Aizoaceae.

86. Molluginaceae. 87. Apiaceae. 88. Araliaceae. 89. Alangiaceae. 90. Rubiaceae. 91. Asteraceae. 92. Stylidiaceae. 93. Campanulaceae. 94. Lobeliaceae. 95. Sphenocleaceae. 96. Vacciniaceae. 97. Plumbaginaceae. 98. Primulaceae. 99. Myrsinaceae. 100. Theophrastaceae. 101. Sapotaceae. 102. Ebenaceae. 103. Symplocaceae. 104. Oleaceae. 105. Salvadoraceae. 106. Apocynaceae. 107. Asclepiadaceae. 108. Loganiaceae. 109. Buddlejaceae. 110. Gentianaceae. 111. Menyanthaceae. 112. Polemoniaceae. 113. Hydrophyllaceae. 114. Boraginaceae. 115. Convolvulaceae. 116. Cuscutaceae. 117. Solanaceae. 118. Scrophulariaceae. 119. Orobanchaceae. 120. Lentibulariaceae. 121. Gesneriaceae. 122. Bignoniaceae. 123. Pedaliaceae. 124. Acanthaceae. 125. Verbenaceae. 126. Lamiaceae. 127. Plantaginaceae. 128. Nyctaginaceae. 129. Amaranthaceae. 130. Chenopodiaceae. 131. Basellaceae. 132. Phytolaccaceae. 133. Polygonaceae. 134. Aristolochiaceae. 135. Piperaceae. 136. Lauraceae. 137. Proteaceae. 138. Loranthaceae. 139. Santalaceae. 140. Balanophoraceae. 141. Euphorbiaceae. 142. Urticaceae. 143. Ulmaceae. 144. Cannabaceae. 145. Moraceae. 146. Casuarinaceae. 147. Salicaceae. 148. Ceratophyllaceae. 149. Hydrocharitaceae. 150. Burmanniaceae. 151. Orchidaceae. 152. Zingiberaceae. 153. Costaceae. 154. Marantaceae. 155. Musaceae. 156. Strelitziaceae. 157. Cannaceae. 158. Bromeliaceae. 159. Iridaceae. 160. Amaryllidaceae. 161. Hypoxidaceae. 162. Agavaceae. 163. Taccaceae. 164. Dioscoreaceae. 165. Liliaceae. 166. Pontederiaceae. 167. Xyridaceae. 168. Commelinaceae. 169. Flagellariaceae. 170. Juncaceae. 171. Arecaceae. 172. Pandanaceae. 173. Cyclanthaceae. 174. Typhaceae. 175. Araceae. 176. Lemnaceae. 177. Alismataceae. 178. Limnocharitaceae. 179. Najadaceae. 180. Aponogetonaceae. 181. Potamogetonaceae. 182. Ruppiaceae. 183. Zannichelliaceae. 184. Eriocaulaceae. 185. Cyperaceae. 186. Poaceae.

Fauna of Bihar

The jungles of Bihar abound in wildlife, though some of the notable game animals and birds like tiger, deer, buffalo, duck etc., are fast disappearing. In order to prevent the extinction of any species and to preserve them and maintain their balance with nature, thirteen wildlife sanctuaries have been set up. Three sanctuaries are in northern fringe of west Champaran district. As a result of strict management and proper protection given to wildlife, the present form has become much richer than the past and the difficult task of wildlife resusciation and conservation has been greatly acheived, so that some of the rare animals on the verge of extinction, such as elephant, gaur, etc., have considerably multiplied.

3.2.3. BLUE AGENDA

3.2.3.1. WATER AVAILABILITY & WATER STRESS

The water resources of the state is monitored through major, medium and minor irrigation schemes. The surface water is managed through major and medium irrigation projects governed with a network of canal system Viz; Son, Kosi, Gandak and Chandan-Badua river irrigation project, whereas the minor irrigation is managed by river lift irrigation, deep tubewells, shallow tubewells, dug wells, tanks and bamboo boring schemes. The irrigation potential created through these sources till 1991 was 35.6 lakh hectares of which surface water irrigation was 26 lakh hectares and ground water irrigation was 9.6 lakh hectares against the irrigation potential of about 122 lakh hectares so far estimated (65 lakh hectares through surface water and 57 lakh hectares through ground water).

The water quality of major rivers of the state such as Ganga, Ghaghra, Sone and Gandak are being monitored. Annual average of some of the important parameters for the years 2003-04 to 2005-06 of these rivers are presented in Table-70 to 72. It is evident from these results that parameters like pH, DO and BOD are within the acceptable limits whereas, coliform countes exceeds prescribed limits even for bathing purposes.

As reported by Public Health Engineering Department, Government of Bihar nine north easter districts viz; kishanganj, Purnea, Katihar, Madhepura, Araria, Saharsa, Supaul, Khagaria & Begusarai are affected by excessive Iron while some of the districts nomely Gaya, Nawada, Jamui & Munger are affected by excessive flouride. The 11 districts bordering Ganga are affected by excess Arsenic content in drinking water sources. Excess nitrate in few habitations has also been noticed, and (ii) ground water is used for drinking purposes and water is mainly drawn through hand pumps.

The Plate No. 11 exhibits sourcewise irrigation through canal, deep tubewell, shallow tubewells and bamboo borings on district base alongwith the command area of canal systems. Distribution different types of wells in districts of Bihar is also presented at Table - 73.

TABLE - 70

Year 2003-2004

Sl.	River	Sampling Stations	Annual Average Values of Parameters				
			pH Value	D.O. mg/L	BOD mg/L	T.C. MPN/100 mL	FC MPN/100 mL
1.	Ganga	(i) Baxur	8.18	8.19	1.96	4240	1360
		(ii) Patna U/S	7.97	8.05	1.72	1890	920
		(iii) Patna D/S	7.9	8.06	1.96	4870	1100
		(iv) Mokama U/S	7.6	7.78	2.06	4300	1225
		(v) Mokama D/S	7.59	7.58	5.32	11600	2500
2.	Ghaghra	Chapra	8.15	8.1	1.64	1911	850
3.	Sone	Koelwar	7.94	8.17	1.62	2420	772
4.	Gandak	Sonepur	8.06	8.05	1.51	1055	480

TABLE - 71

Year 2004-2005

Sl.	River	Sampling Stations	Annual Average Values of Parameters				
			pH Value	D.O. mg/L	BOD mg/L	T.C. MPN/100 mL	FC MPN/100 mL
1.	Ganga	(i) Baxur	8.17	7.24	2.02	12022	2911
		(ii) Patna U/S	8.06	8.27	1.87	6475	1544
		(iii) Patna D/S	8.09	8.25	2.05	13066	5100
		(iv) Mokama U/S	8.13	8.21	1.78	1900	1039
		(v) Mokama D/S	8.16	8.1	2.11	5916	1550
2.	Ghaghra	Chapra	7.9	8.2	1.58	1236	687
3.	Sone	Koelwar	7.9	8.01	1.6	1044	523
4.	Gandak	Sonepur	8.0	8.13	1.54	1038	532

TABLE - 72

Year 2005-2006

Sl.	River	Sampling Stations	Annual Average Values of Parameters				
			pH Value	D.O. mg/L	BOD mg/L	T.C. MPN/100 mL	FC MPN/100 mL
1.	Ganga	(i) Baxur	8.14	8.04	2.13	18133	7883
		(ii) Patna U/S	8.04	8.30	2.04	19892	7517
		(iii) Patna D/S	8.08	8.25	2.20	38292	10458
		(iv) Mokama U/S	7.95	8.00	2.06	14540	7310
		(v) Mokama D/S	8.02	7.90	2.30	45000	15900
		(vi) Munger	8.03	8.20	1.90	10133	5400
		(vii) Bhagalpur	7.83	8.20	2.06	15900	7700
		(viii) Kahalgaon	7.92	8.08	2.14	22875	9733
2.	Ghaghra	Chapra	7.96	8.02	1.83	3708	1867
3.	Sone	Koelwar	7.90	7.90	1.80	7542	3525
4.	Gandak	Sonepur	7.94	8.01	1.70	4100	1948

TABLE - 73

DISTRIBUTION OF DIFFERENT TYPES OF WELLS

Districts	No. of Dug wells	No.of STW	No. of DTW	No. of bamboo boring
1	2	3	4	5
Aurangabad	12822	19124	191	-
Bhagalpur & Banka	11197	10634	213	6411
Vaishali	2702	23608	120	1189
Bhojpur	6951	25306	364	1329
Begusarai	95	25524	309	1961
Purbi Champaran	125	26663	259	779
Paschim Champaran	67	15622	107	2180
Darbhanga	11	10,045	244	1846
Gaya	24394	17790	122	-
GopalGanj	2810	17751	83	2377
Khagaria	14	3168	149	8300
Katihar	-	11270	76	12565
Muzaffarpur	670	36651	687	1174
Munger & Jamui	12589	16303	799	920
Madhepura	3	17040	17	31616
Madhubani	18	14276	203	133
Nawada	6893	11443	328	1934
Nalanda	19965	11267	224	-
Patna	11730	25230	492	1363
Purnia	-	2376	6	33682
Sitamarhi	87	21732	281	2398
Jehanabad	8147	17690	256	-
Kishanganj	-	2378	6	-
Araria	-	2378	22	-
Rohtas & Bhabua	31597	28811	193	-
Saran	7876	27274	274	-
Siwan	8273	26531	77	1968
Samastipur	146	29816	203	2011
Saharsa & Supaul	7059	21771	21	13806

3.2.3.2. Water Stress

Area irrigated by different sources, districtwise is presented in Table - 74

TABLE- 74

District wise area Irrigated
by Different sources (in hectare)

Districts	Canal	Tank	Tube Well	Dug Well	R.L.I.	Other Sources
1	2	3	4	5	6	7
Aurangabad	123946	-	18614	3655	-	50964
Bhagalpur & Banka	144645	15346	43983	5615	188	48330
Bhojpur	221284	13763	52745	5289	-	28431
Begusarai	-	28	61851	1736	-	616
Purbi Champaran	64359	3211	47837	7700	2743	9530
Paschim Champaran	112179	3264	7741	6851	-	27353
Darbhanga	-	6840	29169	-	215	5674
Gaya & Jehanabad	26469	10274	75342	10547	-	102404
Gopalganj	60692	1909	39423	2219	-	542
Khagaria	-	-	30643	6714	-	9517
Katihar	7731	449	43343	-	-	10308
Muzaffarpur	15523	2053	69564	241	-	8414
Munger & Jamui	56553	4917	44913	6561	-	26362
Madhepura	43284	-	30558	-	-	2199
Madhubani	7217	12939	2779	37	1706	12296
Nawada	9306	289	23519	1630	-	99400

1	2	3	4	5	6	7
Nalanda	-	6017	111881	4597	-	82186
Patna	43175	6235	75819	2784	2984	38038
Purnia, Araria & Kishanganj	81207	54	49676	-	5	7959
Rohtas & Bhabua	372883	8047	56921	2363	-	41678
Saran	15921	2400	-	9459		
Samastipur	-	1472	72185	882	-	2357
Saharsa & Supaul	45297	4042	31604	332	-	131155
Sitamarhi	-	6250	15147	4798	-	28854
Vaishali	-	-	31007	1018	8790	15367
Jehanabad	12317	4432	28188	4917	-	76201
Siwan	19019	2124	81933	2313	-	3899
Total	**15,29,647**	**1,44,721**	**12,80,145**	**1,32,357**	**1,00,950**	**8,47,156**

The canals and tubewells are the two major sources of irrigation in the state. The tubewells share 31 per cent of the total irrigated area whereas the canals share 38 per cent. The dug wells, river, lift Irrigation and other sources have contributed 3.2%, 3.5% 2.5% and 20.9% respectively. The map of Bihar showing stress aspect in groundwater utilisation is shown in Plate No. 12.

The Sone river project irrigates mainly parts of Bhabhua, Bhojpur, Rohtas, Jehanabad, Aurangabad and Patna districts, the Gandak river project irrigates mainly the parts of Purbi and Paschim Champaran, Muzaffarpur, Gopalganj, Siwan, Saran districts. The Kosi river project irrigates parts of Saharsa, Araria, Madhepura, Purnia and Katihar districts whereas the Chandan - Badua irrigates Jamuai, Banka, Munger and Bhagalpur districts.

The water logged area mainly falls in the Gandak and Kosi basins.

3.3 ACTIVITIES (D = DRIVING FORCE) :

3.3.1. Geogenic :

(A) land Erosion & Soil Pedogenesis

The data on land use classification including areas effected by soil erosion and land degraded are summarised in Table - 75 to 77.

TABLE - 75 : Districtwise Area Effected with Soil Erosion

Sl. No.	Name of Distt.	Area effected by Soil erosion (000 ha)
1.	Bhagalpur (Banka + Bhagalpur)	100
2.	Munger (Jamui + Munger)	120
3.	Nawada	64
4.	Gaya	90
5.	Aurangabad	50
6.	Rohtas (Sasaram + Kaimur)	119
		543 or 5.43 Lakh ha.

(Source : Director Soil conservation, Bihar, Patna. Reference Letter No. A/N.I.S.-/Tech/38/93-92-854/L.S. dt 15-10-2004.)

TABLE - 76 : Land Use Classification of Bihar

	Total Geographical Area : –	(Unit in Lakh ha) 93.00
i.	Forest	6.16
ii.	Barren and Non-Cultivable Land	4.37
iii.	Land put to Non Agricultural Uses	16.38

iv.	Culturable wasteland	0.46
v.	Parmanent Pasture Grazing land	0.18
vi.	Miscillaneous crops & Groved	2.31
vii.	Other fallow (2 to 5 tears)	1.39
viii.	Current fallow	5.67
ix.	Net area sown	56.68
x.	Total cropped area	79.95
xi.	Area sown more than once	23.27

(Source : Directorate of Statistics & Evaluation, Bihar, Patna, 2002**)**

TABLE - 77 : Status of Land Degradation in Bihar

Sl. No.	Nature of Problem	Area (Lakh hect)
1.	Soil Erosion	5.43
2.	Saline-Alkaline	3.00
3.	Water logged Marshy land a chaur land	9.41
4.	Mining & Quarries	-
5.	Tal Land	1.06
6.	Diara Land	11.56

Pedogenesis : The characteristics of the chronoassociations indicate that decalcification, translocation of clay, sesquioxides and organic matters, plasma separation and weathering of minerals are the active pedogenic process. Five chronoassociations, representing different stages of pedogensis are identified and correlated with the five age groups in the ten morphostratigraphic units of the region.

Member	Soil Geomarphic Unit
QG1	Flood plains of Gandak, Ghaghra and Ganga
GG2	younger Gandak plain
QG3	Older Gandak plain
QG4	Oldest Gandak plain
QG5	Old Ghaghra plain, Ganga and Ghaghra interfluve

PHASED IMPLEMENTATION OF THE PROGRAMME

SHORT TERM PREPARATORY PHASE -PILOT PROJECTS (2002-2007)

1. North-East wards sodic soil Sub-Humid region –

In Bihar the degraded areas suffer due to poor irrigation practices in the command areas of Koel and Gandak canal systems. Sodification has taken place damaging physical conditions (Soil structure) and chemical properties of Soil. Considerable areas have been rendered unclultivated. A world Bank project in some areas of Gandak Command has given good results of community managed reclamation and sustainable use of degraded land resources. The treatment include compartment building, application of soil ammendments by gypsum and physites & pudding, horizonatal drainage through community managed surface drains and vertical drainage through net work of shallow tube wells. Rice-wheat rotation is practised. During summer months cultivation of vegetables and pulses with tube well irrigation brings sub surface water on ground which is lost through evapotranspiration, increasing the soil profile storage capacity. Treatment is necessary with technology refinement to reduce the cost, so that entire degraded lands should be treated to check further sodification of adjoining lands. A provisional estimate of Rs. 20,000/- per Ha is assessed.

2. Drainage congestion water logged sub Humid region

There is considerable drainage congestion areas in the Himalayan foot hills regions in the Canal systems of Kosi & Gandak. Due to drainage congestion, there is water logging. This area can not be drained because of non-availability of out fall due to sand casting and silt deposits. Water logging is a great health hazard like malaria in human beings and liver fluke and foot & mouth diseases in live stock. Movebility & transport are also adversely affected. The combined effect is, shortage of food, malnutrion, health hazards and environmental degradation. Technology like desilting and construction of village ponds with fish culture are being introduced.

A. Flood :

Bihar has always been a worst victim of flood, particularly the areas north of Ganga. Though some mesores to check the menance through Bandh & channels dames have been taken but they are still proving for less than adequate. If properly addressed, the tract of Bihar is full of econmomic possibilities.

B. Seismicity :

Bihar being close to sesmically active Himalayas is prone to sesmic hazards which have in past caused immense loss of lives and property mainly due to damage of structures. If due care of earthquake proof designs are practised, this would, to a large extent, mitigate this hazard.

Various thematic maps showing the earthquake zones, multihazard zonation and flood zone demarcation are listed as Plate No. 13, 14 & 15. The damages caused due to floods in terms of crop damage, public property damage and houses and infrastructural damage are shown in the following Fig. 8, 9, 10.

DAMAGE

Fig. - 8

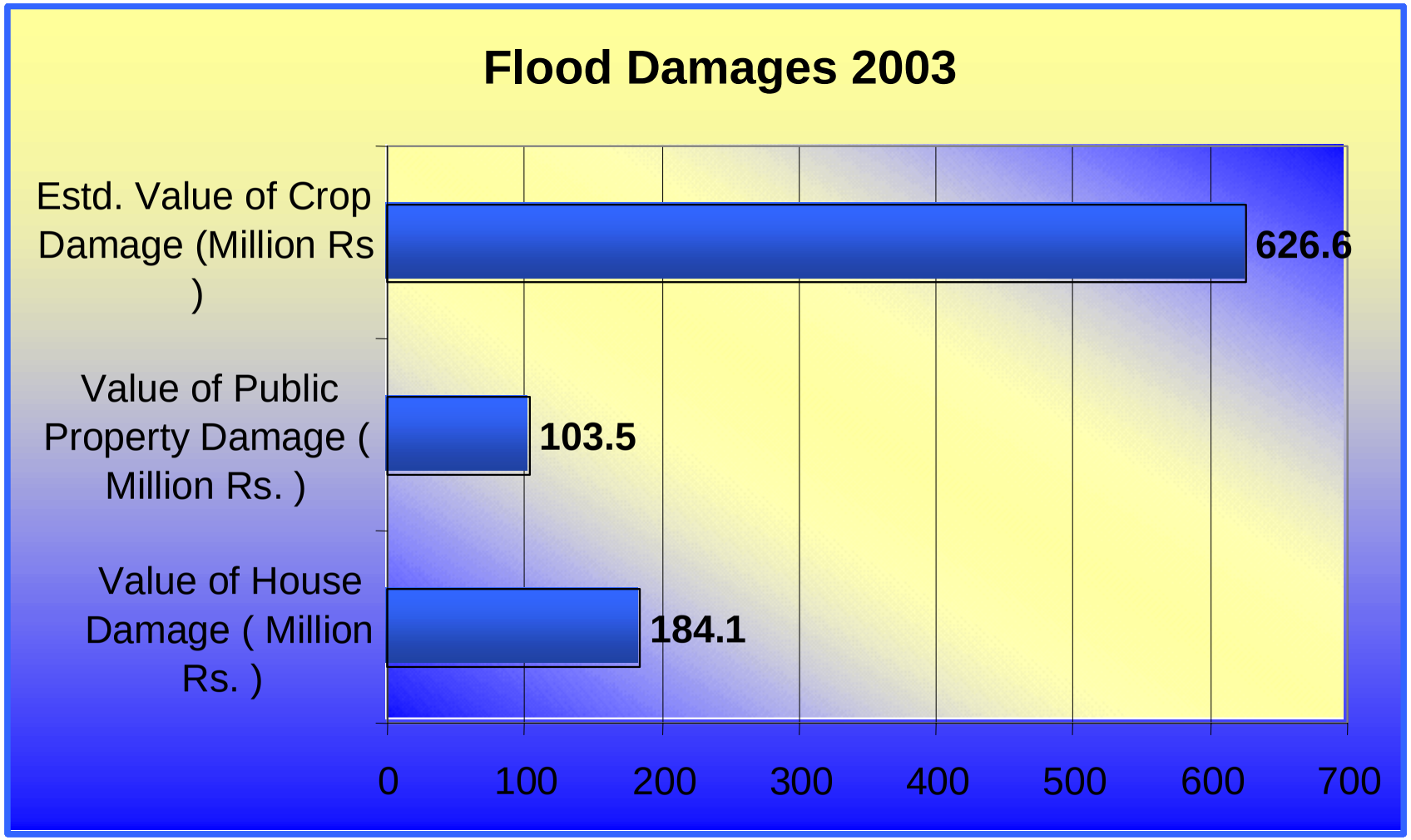
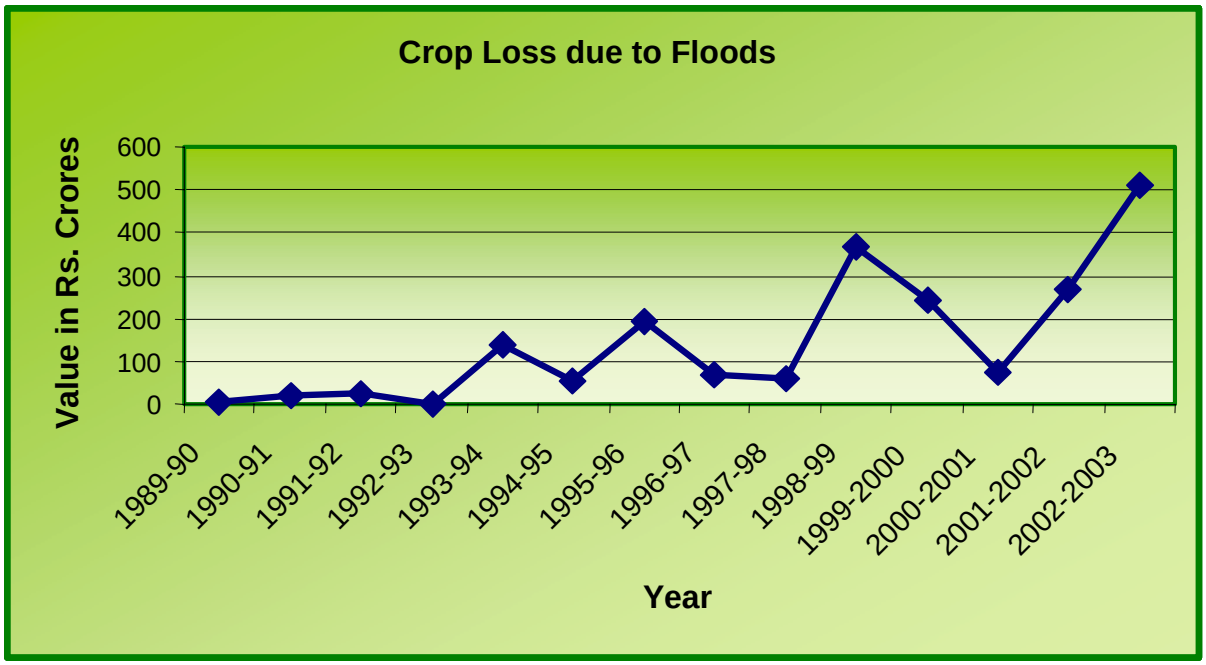

Flood Damages 2003
Estd. Value of Crop Damage (Million Rs)
626.6
Value of Public Property Damage (Million Rs.)
103.5
Value of House Damage (Million Rs.)
184.1
0
100
200
300
400
500
600
700

Fig. - 9


Crop Loss due to Floods
Value in Rs. Crores
600
500
400
300
200
100
0
1989-90
1990-91
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999-2000
2000-2001
2001-2002
2002-2003
Year

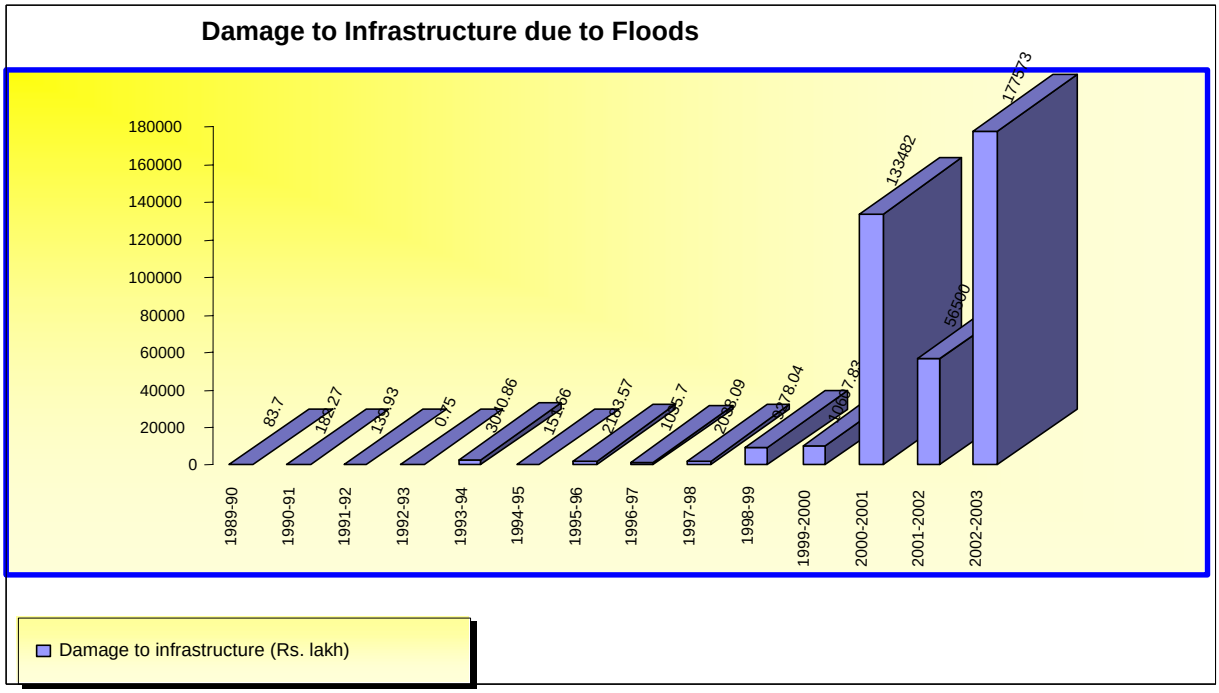
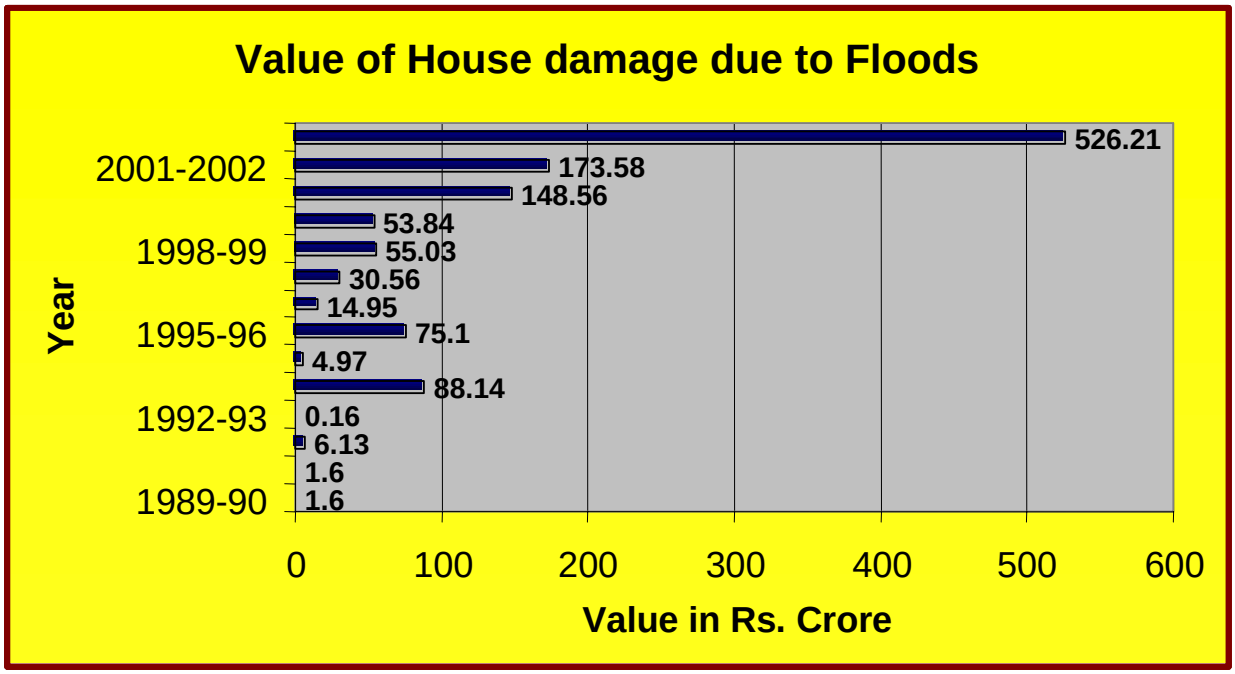
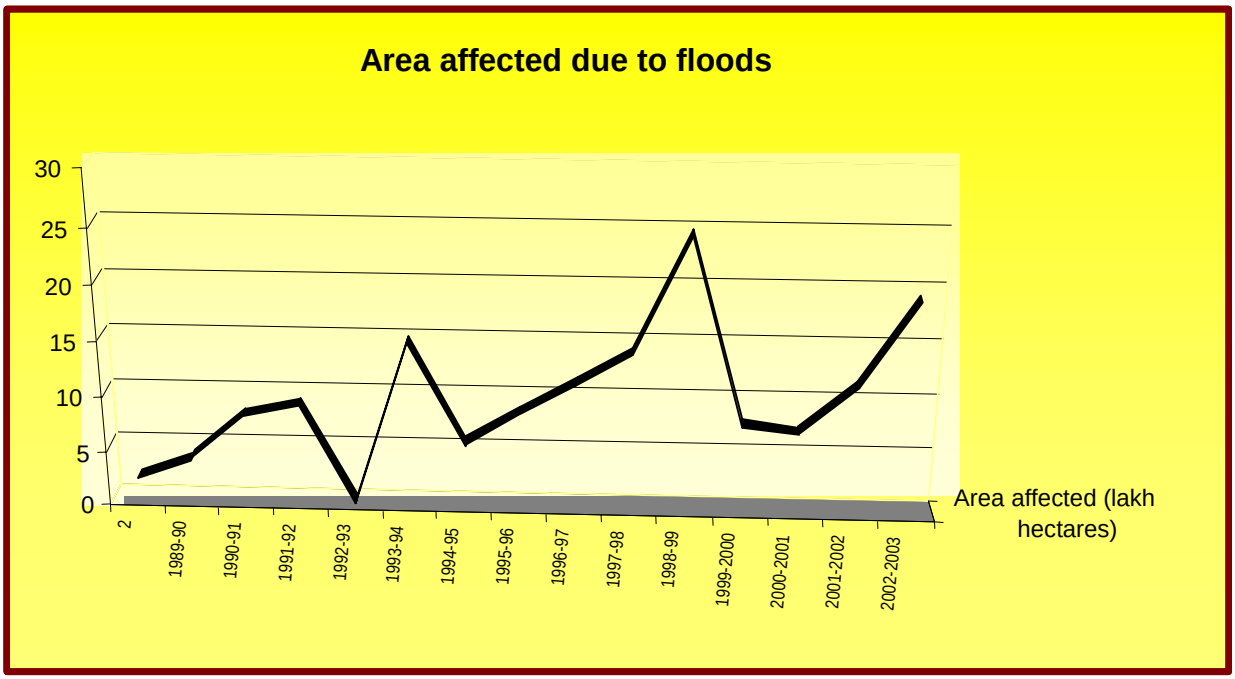

Damage to Infrastructure due to Floods
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
83.7
189.27
139.93
0.75
3040.86
1521.66
2183.57
1095.7
2058.09
2278.04
1097.83
133482
56580
177573
1989-90
1990-91
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999-2000
2000-2001
2001-2002
2002-2003
Damage to infrastructure (Rs. lakh)

Fig. - 10


Value of House damage due to Floods
Year
2001-2002
1998-99
1995-96
1992-93
1989-90
526.21
173.58
148.56
53.84
55.03
30.56
14.95
75.1
4.97
88.14
0.16
6.13
1.6
1.6
0
100
200
300
400
500
600
Value in Rs. Crore


Area affected due to floods
30
25
20
15
10
5
0
2
1989-90
1990-91
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999-2000
2000-2001
2001-2002
2002-2003
Area affected (lakh hectares)

3.3.2. ANTHROPOGENIC ACTIVITY

(A) URBANIZATION

Bihar is the second densely populated state in the country, despite being the least urbanized.

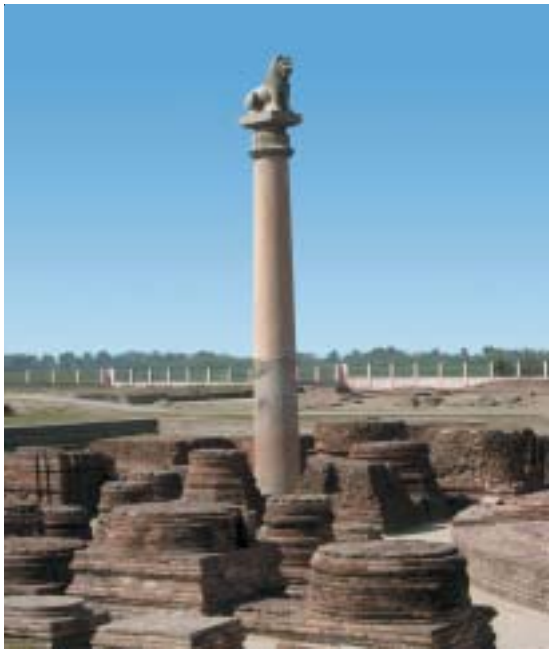
But more interestingly in Bihar we see a reversal of the trend of fast rising urbanization, seen not only in the rest of the country, but also the entire developing world. More significantly there seems to be a reverse flow in the last decade with urban Bihar actually contracting from 11.4 million in 1991 to 8.7 million in 2001, a decrease of 23.6% though the State's decennial population growth rate of 28.4% was among the highest in the country. No Other state in India has had a decrease in urbanization.One reason for this has to be the "loss" of Jharkhand with large towns like Ranchi, Dhanbad and Hazaribagh and with the urbanized population accounting for 6 million of its 26.9 million. Even after factoring Jharkhand back into Bihar, the level of urbanization in 2001 was 13.19%, which is marginally less than what it was (13.38%) in 1991. If we were to assume that the industrial towns of Ranchi, Dhanbad and Jamshedpur now in Jharkhand grew faster, then quite clearly urban growth in the truncated Bihar has been negative. Further evidence of a distinct trend against urbanization in Bihar seen in the fact that from among the principal cities in India, Patna has registered the lowest growth (19.7%) in the decade 1981-91.

It is generally well known that the sections most likely to migrate from rural areas are the economically weakest sections, mostly landless labour, and educated youth. The first find employment mostly in the construction sector, which largely requires unskilled labour. The educated youth particularly those with vocational training and technical education gravitate towards industrial centers.

In addition to the low industrialization of truncated Bihar, there is little by way of urban construction or renewal in Bihar.

THE BIHAR URBAN SCENARIO

The density of population in Bihar is 880 per square km, whereas the corresponding



All-India figure is 324 per square km, yet in terms of urbanization Bihar has the least number of people living in towns with just 15.2% residing there as compared to 28.8% in the rest of the country even than Bihar does not find better education and health facilities in the urban areas. This is seen from the fact that Bihari students migrate in large numbers to other states for education. It would be pertinent to note that the per capita investment in education in Bihar is only Rs. 484.1 and per capita investment in health is only Rs. 86.2, whereas the corresponding All-India per capita figures for education is Rs. 586.8 and health is Rs. 157.2.

Till 1991 in terms of basic urban facilities like safe drinking water and electricity availability Bihar was the worst off among all states.

B. INDUSTRIALISATION

Industrial Incentive Policy, Bihar - 2006

Under the State Reorganisation Act, the bifurcation of the State of Bihar became effective from the 15th of November, 2000. A large number of medium/ large industries, minerals as well as mineral based units and important forest produce have gone to the newly created Jharkhand State. However, the large and medium sector of industries comprises suger mills, distilleries, oil refinery, thermal power plant, cigarette manufacturing, cement, tannery, foundries etc., are located in the state.

There are nine suger mills presently under operation and located in north Bihar area. All the sugar mills have proper arrangement to treat their waste. All the distillaries of the state are having effective effluent treatment plants and generating methane gas by anaerobic treatment of the waste. The methane gas so produced is used as fuel in their boilers conserving fossil fuels. The other major units of the state like Barauni refinery, thermal power plant at Kahalgaon, cigarette manufacturing unit at Munger etc., are also equipped with pollution control devices.

For sustainable industrial state it is imperative that truncated Bihar adopts a resurgent industrial policy. Based upon the raw materials and resources available in Bihar, a renewed effort has to be made to establish small/medium and large industries as well as to rehabilitate the sick and ailing industries of the State.As a result the State of Bihar has reviewed its earlier industrial policy of 2003 and came up with Industrial Incentive Policy 2006 with an objective for a balanced industrial growth in the state. The Industrial Incentive Policy, 2006 is reproduced below:

Resolution

SUBJECT: INCENTIVE POLICY-2006 FOR ACCELERATED INDUSTRIAL GROWTH OF THE STATE.

Today there is a requirement to provide a new industrialized shape full of industries to Bihar State. There is a need to establish new industries and to revive the sick and closed units of the state. For this purpose favorable environment should be created to attract the investors of state and from abroad. In this connection the Industrial Policy - 2003 has been

reviewed. After reviewing the policy, a decision has been taken to prepare a new industrial policy in the present circumstances so that there may be a balanced industrial growth in the state.

In the light of the aforesaid facts a new Industrial Incentive Policy - 2006 has been prepared in consultation with Bihar Industries Association, Bihar Chamber of Commerce, Confederation of Indian Industry and all concerned Government Departments. In the preparation of this policy the Industrial policies of different states have been kept in view.

Under this Industrial Incentive Policy- 2006 there are provisions for granting preproduction incentive of subsidy/exemption from stamp duty and registration fee and post production incentive of grant/exemption for preparation of project reports, purchase of land/shed, technical know-how, captive power generation/diesel generating set, quality certificate. Vat, luxury tax, electricity duty, conversion fee, market fee etc.

With the implementation of this Industrial Incentive Policy- 2006, it is expected that there will be growth in the per capita income of the state and industrial growth as well as accelerated employment opportunities.

1.2 STRATEGY

(i) To create favorable circumstances in order to establish industries in the State so that among the investors, there may be positive communication.

(ii) Bihar Single Window Clearance Act - 2006 -

To promote all round development of the state and industrial growth rapid clearance procedures for establishing industries, to issue license and certificates, to provide a congenial atmosphere to the investors of Bihar state and in this regard and for other concerned subjects Bihar Single Window Clearance Act - 2006 has been enacted.

(iii) Bihar Infrastructure Development Enabling Act- 2006 –

To provide for rapid development of physical and social infrastructure in the State and to attract private sector participation and to provide for a comprehensive legislation for designing, financing, construction, operation, maintenance of infrastructure projects, so that administrative and procedural delays are reduced, for identifying generic project risks, Bihar Infrastructure

Development Enabling Act, 2006 has been enacted.

(iv) In order to simplify the inspection of factories, provision of self-certification will be made.

(v) Industrial growth is adversely affected due to the complicated labour laws.Such labour laws will be made simple and development oriented.

(vi) Human resources will be developed in such a way, which can promote and create industrialization of high degree. Besides existing different institutions will be strengthened to improve skill.

(vii) Land Bank- To meet the requirement of land for industries and development schemes, Land Bank will be established in the state. By this Bank, Land will be made available according to the requirements to different industries and for development schemes.

(viii) Marketing arrangements will be made for small, tiny, cottage industries, handloom and handicraft.

(ix) For the creation of the basic facilities of international level, to enhance capital investment in the industrial areas and invite the private sector for investment and to encourage public private partnership for this purpose.

(x) Development of Infrastructure.

(xi) In order to revive sick units, to identify such units and to suggest necessary remedial measures and to prevent sickness by developing a district level monitoring system.

(xii) To develop handicraft, handloom, khadi, silk and village industries.

Incentives/exemption facilities for Industries in Bihar to accelerate Industrial development and to attract investments.

1. PRE - PRODUCTION INCENTIVES

Stamp duty and Registration fee:

Tiny, small, medium and large scale industries which are to be established in the industrial area / shed and outside the area of the Authority will enjoy the full (100%) exemption in stamp duty and registration fee in lease / sale / transfer. This facility will be granted only for the first time and thereafter will not be granted.

2. POST-PRODUCTION INCENTIVES

(i) Project- Report Incentive:

Reimbursement of the cost incurred in the project report preparation by the industrial units at the rate of 50% subject to a maximum of Rs.75,000/- will be made available provided, the project report is prepared by any of the firms recognised by the Industry Department. The reimbursement will be made to the unit after commencement of the production.

(ii) Incentive granted on land/Shed:

The Industrial Units located in Bihar Industrial Area Development Authority / Export Promotion Industrial Park / Food Park / Agri Export Zone would be eligible for the following incentive / subsidy. These facilities / concession to the industrial units will be made available only after the commencement of production.

Sl. No.	Industry	Grant
1.	Small/Tiny units/Financial Limit.	50% or 7.50 lacs (Maximum)
2.	All large/medium/mega units/Financial Units	25% or 15 lacs (Maximum)

(iii) Financial assistance for Technical-know-how:

If an entrepreneur obtains Technical Know-how from any recognised National research center / laboratory or institution to establish or to expand his industry, he will be reimbursed 30% (maximum Rs. 15.00 lacks) of the fee paid to the institution/organization for the technical know-how. This facility will be provided to the unit after commencement of production.

(iv) Incentive Grant for capital investment on Captive Power Generation/ Diesel Generating Set:

50% (Fifty percent) of the amount Spent on plant and machinery in the establishment of Captive Power Generation/Diesel Generating set will be granted to the industry. No upper limit for this amount has been fixed. This facility will be made available after the unit comes into production.

(v) New industrial units will be granted relief from payment of electricity duty under the Bihar Electricity Duty Act, 1948 for the generation and for own consumption of electricity from D.G. Set and Captive Power Units.

(vi) Subsidy / Incentive on VAT:

This facility will be available to Small / large / medium industries. The industrial unit will get a passbook from the State Government in which the details of the tax paid under Bihar VAT would be entered and verified by the commercial Taxes Department in the form prescribed in Appendix - III. The Director, Industries will be authorised to pay the incentive amount on the basis of the verification.

The new Units will avail 80% reimbursement against the admitted VAT amount deposited in the account of the Government, for a period of ten years. The maximum Subsidy amount is payable 300% of the capital Invested.

Clarification: The incentive would not be payable on the amounts imposed as penalty and the difference of amount between tax assessed and accepted under the Central Sales Tax/Bihar Value Added Tax Act, 2005 and Bihar Entry Tax Act.

(vii) Zero VAT:

Zero VAT means the production of items, which do not attract VAT. Such units which produce items attracting zero Vat and Pay income tax would be eligible for incentive upto a maximum utilization of 70% of the installed capacity (maximum limit) as per para (vi) above. Incentive will be payable after the inspection/recommendation by a committee constituted under the chairmanship of the Director Industries on the basis of inspection and recommendation by technical officer of the Department.

(viii) Besides aforesaid subsidy / concessions, the following exemptions will be provided:

a. 100% exemption for seven years in luxury tax for seven years
b. 100% exemption in electricity duty for seven years.
c. 100% exemption in conversion charge.
d. 100% exemption in market Fee for seven years.

(ix) Facilities granted for the units working under adverse situation:

Such working units which have been working under adverse situation for years will be reimbursed 25 percent of the deposited VAT amount in the account of state government against admitted VAT amount. This reimbursement will be admissible for five years continuously.

(x) Industrial Rehabilitation Fund:

In order to revive the sick and closed industry, with the co-operation of the Commercial Banks, the State Government and Bihar Industry Association, a corpus fund will be created.

(xi) S.C / S.T / Women / Handicapped:

a. Under this category, entrepreneurs will avail 5% additional grant/exemption/ subsidy than the limit fixed under this policy.

b. Up to a turnover limit of Rs.30 lakhs per annum S.C / S.T. / Women / Handicapped category entrepreneurs who run small and tiny industries will avail 100% subsidy of the deposited amount in the account of Government in the form of VAT for a period of ten years.

(xii) Exemption from AMG / MMG:

Working units at present and new units will avail exemption from AMG / MMG from the date of declaration of the New Industrial Policy. This facility will be granted for five years.

(xiii) Central Sales Tax (CST):

Only 1% CST will be payable on the items produced by the registered small and medium units in Bihar.

3. INDUSTRIAL SICKNESS:

3.1 Rehabilitation of Sick Units

Industrial sickness is a part of the process of industrialization. It leads to unemployment, blockage of capital, loss of state revenue and non-utilisation of assets. Hence it is necessary to take proper steps in order to rehabilitate the sick industries. As such govt. is concerned about this and would take the following steps to stem sickness and revive sick industries.

3.2 Small Sector

(i) State Level Committee: For the rehabilitation of small industry a State Level Committee under the chairmanship of Director of Industries will be constituted. Its members comprise representatives from the banks, financial institutions, Reserve Bank of India, Industries Association, experts and Government.

(ii) The above committee would be empowered with necessary statutory powers in order to rehabilitate the sick industry so that approved rehabilitation package may be implemented effectively.

(iii) The guidelines of the Reserve Bank of India / IDBI / SIDBI would be relied upon to identify sickness in sick and small units. Appropriate rehabilitation package would be approved for their rehabilitation.

(iv) The sick industries being revived will not require sickness certificate on an annual basis, instead the revival package shall specify the period of revival of sick units.

(v) The industry declared sick by the State Level Committee would be eligible to receive reliefs and concessions from banks and financial institution as per instructions of RBI. These concessions and reliefs will be considered to be given within a definite time frame.

(vi) After the identification of sickness within a prescribed time frame the rehabilitation package would be prepared and the state level institutions would monitor the sick industries and their rehabilitation.

(vii) Those sick and closed units which have availed the benefits of any Industrial Policy in the past can avail even second time the facilities under this policy. If any sick or closed unit wants to avail the benefits under the Industrial Policy for the second time it will avail only the difference between the prior availed amount and the proposed amount under new policy. But this facility for rehabilitation to the unit will be made available only on the recommendation of the concerned committee constituted by the State Government. Such facility to the unit can be made available maximum of two times only.

(viii) Facility provided to the sick and closed units:

Exemptions from Annual Minimum Guarantee (AMG), Monthly Minimum

Guarantee (MMG) and Delayed Payment Surcharge (DPS) would be available to the unit from the date of declaration of the unit as a sick unit. This facility would be admissible for a period of five years.

3.3 Sickness in Medium and Large Industries:

(i) A committee would be constituted under the chairmanship of Secretary Industry to explore the possibility and determine remedies for the revival of medium and large scale industries and Public Sector Undertakings (PSUS) which are sick and not referred to the BIFR and have a potential for revival. The recommendations of the above committee detailing the reliefs and concessions shall be placed for approval before the highpowered committee existing under the chairmanship of the Chief Secretary.

(ii) The rehabilitation package envisaged by BIFR /IRB I/BICICO /BSFC /Bank and state level inter institutional committee shall be placed before the committee under the chairmanship of the Secretary, Industry for consideration and recommendation of Government.

(iii) Sick Industry means such industry, which has been registered by the Board for Industrial and Financial Reconstruction (BIFR).

(iv) Decision regarding closed industrial units shall be taken by a State Level Committee constituted under the chairmanship of Secretary Industries Department.

(v) Those sick and closed units which have availed the benefits of any Industrial Policy in the past can avail even second time the facilities under this policy. If any sick or closed unit wants to avail the benefits under the Industrial Policy for the second time it will avail only the difference between the prior availed amount and the proposed amount under new policy. But this facility for rehabilitation to the unit will be made available only on the recommendation of the concerned committee constituted by the State Government. Such facility to the unit can be made available maximum of two times only.

(vi) Facilities to sick and closed units:

Exemption of Annual Minimum Guarantee (AMG), Monthly Minimum Guarantee (MMG) and delayed payment surcharge to the unit will be granted from the date of declaration of unit as a sick unit. This facility will be available for five years.

4. FACILITIES FOR EXPANSION-DIVERSIFICATION AND MODERNISATION OF UNIT:

Those units undergoing Expansion/Diversification/Modernisation will be eligible for incentives, upon their incremental production as described in Para 2.

5. INCENTIVE ON QUALITY CERTIFICATION:

75% of cost incurred in obtaining certificate of I.S.O. standard (or equivalent) from reputed national/international level organizations, would be reimbursed by the State Government.

6. INFORMATION TECHNOLOGY MISSION:

6.1 The State Government would launch an I.T Mission for the development of Information Technology Industries with the following objectives:

(i) Economic Development.

(ii) Human Resource Development

(iii) To provide simple, effective and transparent administration.

(iv) State of the Art Communication System

6.2 The State Government will provide the following relief / incentive to the Information Technology Sector for its rapid development.

It has been observed that several rules and regulations applicable to industry need not be required for the I.T. industry. As such, there would be a provision of selfcertification and software units would be exempted from the following:

(i) Pollution Control Act to be effective only as per Govt. of India guidelines.

(ii) Legal Power Cuts.

(iii) Zoning Regulations in respect of location.

The following exemptions under the relevant Acts will be applicable to the I.T industries:

(i) The I.T. Industry will be added in schedule-1 of the Bihar Shops and Establishment Act 1953 and concessions under sections 7,8 and 12 (I) shall be extended to it. By this the industry would be given exemption from the provisions relating to the hours of business and weekly closure.

(ii) The hours of work for women employees would be relaxed under section 66 of the factories Act, 1948. Accordingly for I.T. establishments, Women would be able to work between 5 Am and 10 Pm instead of 6Am to 7 Pm in such establishments.

(iii) I.T industry will be provided with exemptions under section 87 of the Employees State Insurance Act 1948.

(iv) The information Technology industry will be added as an independent employment in the schedule of minimum wages Act 1948 so that the workers may be classified separately.

6.3 Information Technology and Biotechnology industries established in the state would qualify for the incentives under para-2 of the policy. All incentives applicable to industries would also be automatically available to I.T. and Biotechnology Industry.

6.4 The Industry Department will promote Biotechnology and Information Technology on priority basis in industrial areas.

7. HANDLOOM SECTOR:

(i) Electricity Tariff- In view of the state powerloom to be competitive with the power loom sector of other states, there will be a provision of electricity grant of 75 paise per unit of in electricity tariff.

(ii) Quality power supply will be made available for powerlooms.

(iii) Workshop-cum-residence scheme for weavers- In weavers dominated area, scheme of construction of common facility centre and in case weavers do not have the room, land, construction of Government shed would be implemented. All the facilities available under Cluster Development Programme would be available to weavers. Arrangements for training under the scheme would be made.

(iv) Establishment of Integrated Textile Park- Textile Park will be established in the State. By this improvement and design, quality up-gradation and assistance in marketing would be available to the weavers.

(v) Establishment of Urban Haat (market)- An Urban Haat will be established in Patna where there will be provision for sale of the handloom and handicraft products.

(vi) Revival of Central Processing Plants -State Government will revive the central processing plant Biharsharif and Dye and Finishing plant, Darbhanga. In these, the weavers may avail the facilities of dying, finishing and processing of their products.

(vii) Reimbursement of loan due of the weavers- Scheme of reimbursement of old loan dues and interest from weavers in the State would be implemented.

8. IMPLEMENTATION OF RESERVATION POLICY:

Those units which comply with the Reservation Policy of the Govt. of Bihar will be given an additional 10% over and above the fiscal incentives for which they are eligible under this Policy.

9. MONITORING AND REVIEW:

All concerned departments and organizations would issue necessary follow up notifications within a month to give effect to the provisions of this Policy. This will be duly monitored by Government so that the State Government may carry out a mid - term review of this Policy.

10. The incentives / subsidies / relief's outlined in this policy shall be available to only such new industrial units which commence commercial production within five years from 01.04.2006.

11. Industries mentioned in the negative list in Annexure - II would not be eligible for any incentive / subsidy.

12. For incentives contained in this Policy a committee would be constituted under the Chairmanship of Secretary Industries with the Director of Industries, Director Technical Development, a representative each of the Commercial Taxes Department, and Bihar State Electricity Board (wherever necessary) as well as the concerned M.D of the Industrial Area Development Authority as its Members. This Committee would decide on post-production incentives to be given to new units.

13. The definitions given in the Annexure to this policy shall be treated as part of this policy.

Order: It is ordered that a copy of the resolution should be sent for publication in the special edition of the Bihar Gazette, Reputed Journals and Newspapers and be circulated among all the Departments / Departmental heads and Subordinates officials of the Government.

By the Order of the Governor of Bihar

(S. Vijayaraghavan)
Industrial Dev. Commissioner, Bihar, Patna.

Memo No: 1162, Patna, Dated 15 / 07 / 06

Copy with enclosure forwarded to the Superintendent, Government Press, Gulzarbagh, Patna for its publication in the special edition of Bihar Gazette.

By the Order of the Governor of Bihar

(S. Vijayaraghavan)
Industrial Dev. Commissioner, Bihar, Patna.

Memo No: 1162, Patna, Dated 15 / 07 / 06

Copy with enclosure forwarded to all Departments / Departmental Heads / Commissioner, Commercial Taxes, Department of Commercial Taxes / Managing Director, All Corporations under Department of Industry / Bihar Industrial Development Authority/ Chief Executive Officer, Bihar Khadi Village Industries Board Patna / Chairman, Bihar State Electricity Board, Patna / All Commissioners/ All District Magistrates / All Deputy Development Commissioners / All General Managers, District Industry Office / Director, Technical Development / Director, Industry / Resident Commissioner, Bihar Bhavan, New Delhi / Director, Small Scale Industries Service Organization, Patliputra Colony, Patna / Muzaffarpur for information and needful action.

By the Order of the Governor
of Bihar

(S. Vijayaraghavan)
Industrial Dev. Commissioner, Bihar, Patna.

ANNEXURE-I

Definitions:

1. **Effective date:** "Effective date" means the date on which the provisions of this Policy come into force i.e. 01.04.2006. This Policy will remain in force for 5 years from the date of issue of orders.
2. **Industrial Unit/Industrial concern**: 'Industrial unit / concern' means any unit / concern engaged or to be engaged in manufacturing / processing / servicing industry under the following categories:
   a) Industries listed under the First Schedule of the Industries (Development and Regulation) Act 1951 as amended from time to time.
   b) Industries falling within the purview of the following Boards / Agencies:
      (1) Small Industries Board
      (2) Coir Board
      (3) Silk Board
      (4) All India Handloom and Handicrafts Board.
      (5) Khadi and Village Industries Commission.
      (6) Any other agency constituted by the Government of India or Government of Bihar for industrial development.
   c) Other categories:
      (1) Mining or development of mines
      (2) The maintenance, repair, inspection or servicing of machinery of any description or vehicles or vessels or motorboats or trailers of tractors.
      (3) The setting up or development of an Industrial Area, Industrial Estate, Integrated Infrastructure Development Export Promotion Industrial Park, Export Promotion Zone or Growth Centre.
      (4) Providing special or technical knowledge or other services for the promotion of industrial growth.
      (5) Providing Engineering, Technical, Financial, Managerial, Marketing or other services or facilities for industry.
      (6) Providing services relating to Information Technology, Telecommunication or electronics including satellite linkage and audio or visual cable communication.

(7) Tourism.

3. Existing Industrial Unit:

"Existing Industrial Unit" means an industrial unit which is in commercial production.

4. New Industrial Unit:

"New Industrial Unit" means an industrial unit in which commercial production has commenced within five years from 01.04.2006.

5. Transferred Unit:

"Transferred unit" means an industrial unit whose ownership / management has been transferred as per the provisions of the State Financial Corporation Act, 1951 or has been transferred with the approval of Financial Institutions / Banks.

6. Sick Unit:

"Sick unit" means an industrial unit declared sick by the Board for Industrial and Financial Reconstruction under the Sick Industries Companies (Special Provision) Act, 1985 or by the State Apex Committee for SSI headed by the Director of Industries or the High Level Empowered Committee headed by the Chief Secretary for large and medium sector.

7. Closed Unit:

"Closed unit" means an industrial unit which has been continuously closed since the last five (5) years from the date of eligibility for applying for incentive under this Policy. Closed means that there should have been no commercial production. The declaration of the unit being "closed" shall be certified as mentioned in Para 3 of this policy.

8. Expansion/Modernisation/Diversification:

"Expansion/Modernisation/ Diversification of an existing unit' would mean additional fixed capital investment in plant and machinery to the extent of 50% or more of the undepreciated value of fixed capital investment in the existing unit leading to incremental production capacity which would not be less than 50% of the initial installed capacity. In order to qualify a unit undertaking expansion/modernisation/ diversification should send prior intimation to the General Manager, District Industries Centers or the Managing Director, Bihar Industrial Area Development Authorities & Deputy Commissioner Commercial Taxes, as the case may be in respect of Small Scale Industry or the Director of Industries/Director, Technical Development and

Commissioner, Commercial Taxes in case of medium and large industries before undertaking such expansion/modernisation/diversification Programme. Such intimation should be accompanied by detailed expansion/modernisation/diversification proposal giving the specific period of proposed additional investment.

9. Fixed Capital Investment:

The 'Fixed capital investment' means an investment made in land, building, plant and machinery as well as productive assets of permanent nature.

10. Small Scale Industry:

A "Small Scale Industrial Unit" is an Industrial unit in which capital investment has been made upto the limit specified by the Government of India time to time.

11. Ancillary Industrial Unit:

An "Ancillary Industrial Unit" is an industrial unit in which capital investment has been made upto the limit specified by the Government of India time to time.

12. Date of Production:

The "date of production" of an industrial unit shall mean the date on which the unit actually commences commercial production of the item for which the unit has been registered.

As regards the date of production of a SSI unit, the certificate issued by the respective General Manager, District Industries Centre of Managing Director, Industrial Area Development Authority would be valid. In case of any dispute regarding the date of production, the decision of the Director on Industries shall be final. In case of large and medium industries the certificate issued by the Director Technical Development would be valid. In case of any dispute regarding the date of production, the decision of the Industrial Development Commissioner/Secretary Industries shall be final.

Those industrial units which commence in production on 01.04.2006 or thereafter, but whose capital investment is prior to 01.04.2006 would be eligible under Industrial Incentive Policy, 2003 (in case they qualify) or under the New Policy as alternative. The units will not be entitled to part benefits of both the policies. Three months from the date of publication of the notification in the Bihar Gazette of this Policy, the units will have to give in writing to Director Industries or Director, Technical Development indicating the preferred alternative.

ANNEXURE-II

List of Industries Not Eligible For Incentives:

1. Rice Huller
2. Flour Mills (Including Besan, Dal & Chura Mills) of less than 50 TPD Capacity.
3. Condiments (Masala & Papad) Mills
4. Confectionery (Excluding Mechanised Confectionery)
5. Preparation of Sweetmeat & Salted Snacks.
6. Bread Manufacturing (Except Mechanized Bakery)
7. Production of Ice Candy and Ice Food.
8. Manufacturing and Processing of Betel Nut.
9. Fireworks and Crackers Units
10. Coal / Coke Screening
11. Firewood and Charcoal Manufacture
12. Painting and Spray Painting Units
13. Fertilizer Mixing Plants.
14. Brick Manufacturing Units (Except Units Engaged in Manufacturing Refractory Bricks and Bricks from Fly Ash, Red Earth, Raw Industrial Waste Material).
15. Manufacture of Tarpaulins Made of Canvas
16. Saw Mills and Wood Sawing
17. Furniture and Wood Sawing.
18. Drilling Rings, Bore Well and Tube Well Establishing Units.
19. Tea Blending/Mixing Units.
20. Units Connected with Cutting of Raw Tobacco and Gul Related Products and Guraku
21. Bottling and Repackaging of Drugs/Pharmaceuticals/Chemicals without Processing and value addition (Excluding formulation and manufacturing units)
22. Book Binding
23. Rubber Stamp Making
24. Notebook and Envelope Making.
25. Photo Copying

26. Stenciling Units
27. Processing of Stencil Papers.
28. Distilled Water Manufacturing Units.
29. Tailoring (Except Readymade Garment Manufacturing Units)
30. Sewing of Socks with Woven Cloth and their Repacking.
31. Laundry/Dry Cleaning.
32. Photography/Studio Labs.
33. Clinical/Pathological Laboratories/Nursing Homes/Clinics
34. Beauty Parlours.
35. Video Parlours
36. Goods Transport.
37. Video/Audio Cassette Recording/Watch Repairing / Vehicle Workshop and Service Stations.
38. Lime Kilns.
39. Petrol Pumps.
40. Narcotic Drugs.

Note:

1. Government reserve the right to make any changes in the above negative list.
2. The decision of Government whether a unit falls in the Negative list or not, shall be final and binding.

ANNEXURE – III

FORMAT OF PASSBOOK AS DETAILED IN PARA 2(VI) OF THE INDUSTRIAL INCENTIVE POLICY 2006.

1	2	3	4	5	6	7	8
Sl. No.	Month	Amount of Tax admitted under BVATA*/ CSTA*/BETA* BVATA*/ CSTA*/BETA*	Amount paid against the amount admitted under amount deposited	Main/ Subsidiary headings under which admitted	Challan no. & date with Name of Treasury	Name & Designation of certifying officer	Signature with date & seal
TOTAL							

***BVATA = Bihar Value Added Tax Act 2005**

***CSTA = Central Sales Tax Act**

***BETA = Bihar Entry Tax Act.**

Note: The passbook entries must be certified by the concerned Commercial Taxes Officer in charge of the circle.

V V V

C. AGRICULTURE

1. Agricultural Resource :

Bihar is one of the states where agriculture is considered as the backbone of economic activity. About 80% of the land area is arable and supported with good monsoon rainfall. Though the agricultural practices are not well developed, but somehow supports the life line through its products.

There are four classes of crop period in Bihar, e.g,. (1) Bhadai (2) Aghani (3) Rabi crop (4) Summer crop.

i. Bhadai : This crop is sown in the month of May-June i.e., in pre-monsoon period and harvested during post monsoon period. It includes the crops such as rice, maize and jute and in some patches pulses and vegetables are also grown.

The districts of Purnia, Saharsa, Madhepura, Supaul, Kishanganj, Katihar are the main areas where such crops yield. Marua is grown in the districts of Muzaffarpur, Vaishali, Saharsa, Samastipur and Sitamarhi.

In the diara lands of Ganga and Kosi belt maize are grown.

ii. Aghani : This is the main crop in Bihar. It contains all the crops which is sown during rainy season immediate after the on-set of monsoon. The main paddy crop is sown till August and harvested in the month of Nov.-Dec. That is why Bihar has its own well established rice culture.

The main rice producing districts are Purnia, Madhubani, Darbhanga, Sitamarhi, Saharsa, Rohtas, etc. Two crops yield of paddy is usually practised because of the fact that a monsoon period prolongs over a wide range.

iii. Rabi Crop : This is the winter crop usually sown in the month of Oct-Nov and harvested in the month of March-April. Wheat is the main product of this period along with other minor pulses and oil seeds.

iv. Summer Crop : During this period summer paddy, vegetables oil seed, maize and pulses are grown.

Main crops yields –

i. Paddy : Paddy is grown about a tune of 65.5 lakh. MT each year. Three types of paddy are produced

(a) Aghani Paddy (80% of the area)

(b) Boro Paddy (2% of the area)

(c) Summer Paddy (3% of the area)

ii. Wheat : Wheat is the second most predominant product. It is produced in about 26.5 lakh. hec land and the yield is of a tune of 35.7 lakh. ton every year. In the past two decades the production in Bihar has increased many fold and it has attained the sixth position in the list of states producing wheat.

The main wheat producing area is Ganga-Diara, Kosi basin, Begusarai district, area falling west of river Bagmati and in the districts of Buxar, Rohtas, Gaya, Jehanabad, Patna, Munger and Bhagalpur.

iii. Maize : Maize is the third main crop of Bihar and is sown in 8% of the cultivable area. It is mainly grown in the area SW of Burhi Gandak River and in the districts of Saran, Gopalganj, Siwan, Samastipur and Purbi and Pashcim Champaran. Approximately 18 lakh metric ton is produced every year.

iv. Barley : Barley is grown in almost similar ground situation as that of maize. It is sown as mixed crop. Purbi and Paschim Champaran are the lead districts in its production.

v. Marua (Ragi) : It is grown in the less fertile sandy soil and needs little water that is why its seed is sown in the month of June and transplanted after rainfall. It is the main food of labour and down trodden class of population. It is grown in the districts of Saharsa, Supaul, Madhepura and Darbhanga, etc.

vi. Pulses : About 12-13 lakh hec. land is used for growing such type of crops. The annual production is of to a tune of 10 lakh MT.

vii. Main Cash Crop : It includes Sugarcane, Tabacco, Potato, Jute and Chilli.

Sugarcane is grown in alluvial soil having lime as main ingrediant. It is noted that area lying east of Bagmati is not suitable for sugarcane cultivation. Broadly, it is the area lying NE of Bagmati river which is considered most suitable for sugarcane cultivation.

Tabacco is grown in 14000 ha. land and the production is of a tune of 17000 ton every year. It is grown mainly on the margin of river banks almost extending from Gandak river in the west to eastern boarder of Bihar.

Potato is the main cash crop and is grown almost in every districts. Nalanda district is considered as the leading producer of Potato.

Jute is produced in the high rainfall and humid area of Bihar. It is grown at the margin of water bodies where pure water is vailable for washing. It is mainly grown in the districts of Purnia, Kishanganj, Katihar Saharsa, etc.

Chilli is a product grown through out the year in about 75,000 ha land.

2. AGRICULTURAL ZONES OF BIHAR :

The state of Bihar has been divided into five zones for agricultural utility which is presented in Table - 78.

TABLE - 78

	Agricultural zones	Main Crops	Geographical Characterestic
(i)	NE Plain	Paddy & Jute	Flood Plain, adequate fertility, sufficient humidity & more than 125 cm rainfall, silty clay to silty loam soil.
(ii)	NW Plain	Paddy & Sugarcane	Falls under Gandak command area & groundwater irrigation, older alluvium soils with domi nance of lime & < 125 cm. rainfall.
(iii)	Mid-North Plain & wheat	Paddy, Maize	Area between Gandak & Kosi, flood affected light silty clay soil, favour rainfall, canal & tubewell irrigation
(iv)	SW Plain Sugarcane	Paddy &	Area lying west of kharagpur hill upto Son river, rice & wheat in wheat selected areas, Son Command area.
(v)	SE Plain	Paddy main crop & maize	East of Karagpur hill, rainfall > 125 cm. drought prone area. in irrigated area, wheat & sugarcane in Diara area.

3. REASONS FOR AGRICULTURAL BACKWARDNESS :

1. The social and political reasons never remain friendly and congenial with the factors governing the Geo-economic aspect of the state. Initially, many pilot projects, e.g., IADP were undertaken in the state but the result was a not satisfactory. The eradication of regional imbalance and personal bias couldn't build the atmosphere for the proper development of the state. Lack of political will, education, inadequacy of information system, social tensions and population explosion are the main reasons for under exploitation of

agricultural land.

2. The other reasons i.e., economics reasons includes, lack of implementation of land & water management, mordernization & industrialisation of agriculture and other infrastructural support for agriculture.

3. The other major reasons for the agricultural backwardness is the extreme population pressure on agricultural land. The various land reforms acts were not effectively executed on ground.

The land & water management, ie, the terms of water imbalance has affected the state perpetually in the form of flood and drought. This remains the major challenge for the development of the state.

4. GREEN REVOLUTION :

The Bihar has failed to get the yield of green revolutions because of the facts summarized below :

A. Due to non-implementation of land reforms 77% of the holding is with the marginal farmers, which comprises 30% of the agricultural land. Persons holding more than 5 hectare land comprises 4% and the total land area under such sector are 30% of the available agricultural land. The increased population of marginal farmers are the main hurdle in the economic development based on agricultural yield.

B. Due to poor purchasing capacity of farmer HYV seeds and improved chemical fertilizers were not utilised.

C. A total of 28 districts of the state are flood affected. During the same span of weather condition some area is affected with flood while the other with drought. The Sone-Ganga river system irrigates about 73% of its command area and the remaining mid-central south Bihar dose not have proper irrigation facility.

D. The seed and insectisides used are not commensurate with the bio-technological consideration.

E. The agricultural activity of the state has never been linked with industry or para industry there by the farmers are deprived of getting assured financial support and encouragement.

CHAPTER- 4

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

The concept of EIA was pioneered in U.S.A. in 1969 with the formulation of National Environmental Policy. The EIA may be defined as –

(a) "A study of probable change in various socioeconomic and bio-physical characteristics of the environment which may result from a proposed or impending action" – Jain et al (1977)

(b) "It is an activity that aims at establishing quantitative values for selected parameters which indicate quality of environment, before, during and after an action – Heer & Hagarty (1977)

EIA is carried out for assessing the requirements of economic growth and preservation of environment. Consequent to the promulgation of Environmental (Protection) Act, 1986, environmental clearance for all new projects and expansion of existing projects have become mandatory. This clearance is given by the Dept. of Environment (DoEn), Ministry of Environment & Forest, Govt. of India or the concerned State Pollution Control Board on the basis of EIA and environmental management plan (EMP) documents.

In order to decide the environmental hotspots and priority issues on the basis of number and extent of problems in each district, the quantitative hierarchy of environmental degradation has been worked out. The quantitative value of problems warrants cost effective action to address these issues with the understanding of its everity and priority.

It is understood that there are some pervasive nature of problems, in all the districts e.g.; drinking water, sewage and sanitation facilities and indoor air pollution which are not taken into account while deciding the hotspot.

The cut-off score for environmental hotspot is taken in any four of the seven environmental problems viz; (1) Disaster (2) Land degradation (3) Bio-diversity loss

(4) Water imbalance (5) Unorganised Urbanisation (6) Industrialisation and (7) Awareness, alongwith their inherent attributes listed in Table - 79.

TABLE - 79

	Env. problems	Attributes
1.	Disaster	(a) Flood (b) Seismicity and (c) Drought
2.	Land Degradation	(a) Soil alkalinity (b) Wet land (c) River erosion (d) siltation and (e) Irrigational Command Area problems.
3.	Bio-diversity loss	(a) Deforestation (b) Non-residency of run-off (c) Siltation of wet land (d) Subsidence of wet-land and (e) River aggradation (Ganga)
4.	Water imbalance	(a) Over exploitation of ground water in selected area (b) Chemical anomoly
5.	Urbanisation	(a) Vehicle pollution (b) Solid waste (c) Sewage and (d) Air pollution
6.	Industrialisation	(a) Mining : (b) Industries
7.	Awareness	(a) Population (b) Health determinants e.g. unsafe water, poor sonitation practices, malnutrition, behavioural attitudes, illiteracy, climatic conditions and poverty.

Thus on the basis of number of problems in each district the quantitative hierarchy of environmental degradation has been brought out in Table No. 80.

The approach for prioritisation is a process whereby the ranking of future action

could be decided so that the issues of greatest impact attract the highest investment relative to the available resources. Therefore, to be able to determine the path by which improvements in environmental management interventions could be effected in the background of politicl commitment, resource availability, administrative capability and public participation through participatory processes, it needs to be placed on record that the outcome should be taken as indicative, requiring further verification by secondary micro-level exercises.

The prioritisation methodology is aimed to derive weightings which are then applied to get scores for the range of seven identified problems. Taking into consideration of primary and secondary source of information to provide guidance on the importance of the different environmental issues in Bihar, an assessment of the magnitude of economic, social and ecological impacts of each problem has been carried out. A score of 1 to 3 has been assigned to low impact, 4 to 6 to medium impact and 7 to 9 for high impacts. Based on the economic, social and ecological factors an impact matrix for the environmental hotspot districts developed, which is presented in Table 80.

TABLE - 80 : ENVIRONMENTAL HOTSPOT DISTRICTS IN BIHAR

District	Disaster	Land Degradation	Bio-diversity	Water imbalance	Unorganised urbanisation	Industrialisation	Awareness	No. of Env. Problems
	1	2	3	4	5	6	7	8
1. Araria	(a) (b-IV & V F)	(b) (d)		(a)		(b)	a^{++} (b)	5
2. Aurangabad	(b III, F), (c)		(a) (b)	(a) (b)		(a) (N.A) (c)	a^{++} (b)	6
3. Banka	(b-IV), (c)		(a) (b)	(b) (b^{+})		(N.A) (c)	a^{+++} (b)	5
4. Begusarai	(a) (b-IV)	(a) (b) (c)	(b)	(a)		(b)	a^{++} (b)	7
5. Bhagalpur	(a) (b-IV)	(c)	(b)	(b^{+})		(b)	a^{++} (b)	5
6. Bhojpuer	(a) (b-IV)			(a) (b^{+++})		(a) (b)	a^{++} (b)	4
7. Buxar	(a) (b-IV)			(a) (b^{+++})		(b)	a^{+++} (b)	4
8. Darbhanga	(a) (b-IV)	(a) (b)		(a)	(a) (b) (c)	(b)	a^{+} (b)	6
9. Gaya	(b-III, IV) (c)		(a) (b)	(b) (b^{+})	(a) (b) (c)	(b) (c)	a^{+} (b)	6
10. Gopalganj	(b-IV)	(a)		(a)		(b) (c)	a^{++} (b)	4
11. Jamui	(b-IV) (c)		(a) (b)	(b)		(N.A)	a^{+++}	4
12. Jehanabad	(a) (b-IV F) (c)	(d)		(b)		(a) (N.A)	a^{+++} (b)	4
13. Kaimur	(b-III) (c)		(a) (b)			(a) (b) (c)	a^{+++} (b)	4
14. Katihar	(a) (b-IV F)	(c)		(a)		(b)	a^{++} (b)	5
15. Khagaria	(b-V)	(a) (c)		(a)		(N.A)	a^{+++} (b)	4
16. Kishanganj	(b-IV F)	(b)		(b^{++})		(b)	a^{+++} (b)	5
17. Madhubani	(a) (b-V)	(d)		(a)		(b)	a^{+} (b)	4
18. Madhepura	(b-IV & V)	(b)		(a)		(N.A)	a^{+++} (b)	5
19. Munger	(a) (b-IV)	(c) (d)	(a) (b)	(b)		(a) (b) (c)	a^{+++}	6
20. Muzaffarpur	(a) (b-IV F)	(a) (b)		(a)	(a) (b) (c)	(b)	a^{+} (b)	6
21. Nalanda	(b-IV)	(b) (d)	(a) (b)	(a) (b) (b^{+})		(N.A) (c)	a^{++} (b)	6
22. Nawada	(b-III, IV) (c)		(a) (b)	(b) (b^{+})		(N.A) (c)	a^{+++} (b)	5
23. Patna	(a) (b-IV F)	(b)	(b)	(a) (b^{+}) (b^{+++})	(a) (b) (c)	(b)	a^{+} (b)	6
24. Paschim Champaran	(a) (b-IV)	(a)	(a) (b)	(a)		(N.A)	a^{+} (b)	5
25. Purbi Champaran	(a) (b-IV)	(b)		(a)		(b)	a^{+} (b)	5
26. Purnia	(a) (b-IV F)	(b)		(a)		(b)	a^{++} (b)	5
27. Rohtas	(a) (b-IV & V) (c)		(a) (b)			(b)	a^{++}	4
28. Samastipur	(a) (b-IV)	(a)		(a)		(b)	a^{+} (b)	5
29. Saharsa	(b-IV)	(a)		(a)		(b)	a^{+++} (b)	5
30. Saran	(b-IV F)	(a) (c) (d)		(a)		(b)	a^{+} (b)	5
31. Siwan	(b-IV)	(a) (d)		(a)		(b)	a^{++} (b)	5
32. Sitamarhi	(a) (b-V, VI)	(b) (d)		(a)		(b)	a^{++} (b)	5
33. Supaul	(a) (b-V)	(b) (d)		(a)		(b)	a^{+++} (b)	5
34. Vaishali	(a) (b-IV)	(b)				(b)	a^{++} (b)	4
35. Sheikhpura 36. Lakhi Sarai	Included in parts of old Munger						a^{+++} (b)	

TABLE - 81 : IMPACT MATRIX FOR ENVIRONMENTAL ISSUES IN BIHAR

Impact factors / Env. Problems	Ecological Impact									TOTAL (1-9)	Social Impact			TOTAL (10-12)	Economic Impact	Total Score
	Abiotic							Biotic								
	Geo-logy	Geomor-phology	Pedo-logy	Surface water	Ground water	Land use	Climate ecology	Land Ecology	Aquatic		Noise Quality	Air Quality	Land use			
	1	2	3	4	5	6	7	8	9		10	11	12		13	
1. Disaster (a) Flood (b) Seismicity (c) Drought	1	1	1	1		1		2	2	9	–	–	8	8	7	24
2. Land Degradation (a) Soil Alkalinity (b) Wet land (c) Rivererosion (d) Siltation (e) Irrig. Comm. area		1	2		1	2			2	8	–	–	6	6	4	18
3. Bio-Diversity (a) Deforestation (b) Non residency of run off (c) Sittation of wet land (d) Subsidence of of wet land (e) River aggradation		1		2		1		3	2	9				5	8	22
4. Water Imbalance (a) groundwater over exploitation (b) chemical hazard					9					9			9	9	9	27
5. Urbanisation (a) Veh. Pollution (b) Solid waste (c) Sewage (d) Air pollution		1	1	1	5	1				9	3	4	2	9	5	23
6. Industrialisation (a) Mining (b) Industries	5					2				7		1	3	4	4	15
7. Awareness (a) Population (b) Health Indicators				1	3			2	3	9			8	8	9	26

5.1 DISASTER :

Drought : Lack or insufficiency of rain for an extended period that severely disturbs the hydrologic cycle in an area is called drought. Droughts involve water shortage, crop damage, stream flow reduction and depletion of ground water and soil moisture. They occur when evaporation and transpiration exceeds precipitation for a considerable period. Drought is the most serious hazard to agriculture in nearly every part of the world.

In Bihar the districts usually affected under this disaster are Kaimur, Rohtas, Aurangabad, Jehanabad, Gaya, Nawada, Jamui and Banka.

Measure of mitigation plan :

(i) Update the data, observations and interpretation with respect to parameters e.g; deficiency in rainfall and run-off, decline in soil moisture, reduction in groundwater levels and the storage required to meet prescribed drafts or demands.

(ii) The drainage basins e.g; Lower reaches of Sone, Punpun, Morhar, Phalgu, Dhadhar, Sakri, Kiul, Chandan and Baudna should be subjected for water balance studies.

(iii) The topographically friendly drainage routes should be examined and considered for diverting the flows successively from Punpun to Kiul, through intermittent channels, from West to East, in the plateau marginal area.

(iv) The geological and geohydrogical region of surface water storage site and groundwater recharge zones are to be identified and equitably distributed as per the need and water holding capacity.

(v) Rain water harvesting should be promoted.

FLOOD AND SHIFTING OF RIVERS :

As a part of river prone disaster the two elements i.e. flood and shifting of rivers are intimately related consequential fluvial phenomena. The most dynamic among rivers is the Kosi, which has avulsed over 120 km of lateral width, from east to west, in about 220 years.

The Gandak has migrated over a distance of 105 km. from west to east. The Sone river has shifted westward since the Epic period, through Budha, Gupta and medieval time. These shifting is concomittent with flood disaster and deluge.

The role of neotectonic changes (Seismic behaviour) has been attributed as the cause for tilting of megafans towards east, leading to shifting of Gandak. The gradual shifting of Kosi towards west may be correlated with the influence of Patna – Muzaffarpur crustal fracture. Though there is no positive correlation with many severe earthquake and floods. The shifting of Sone river is assumed to be an outcome of superimposition of Patna – Muzaffarpur fault over the pre-existent Sone-Narmada basement fracture system.

The hydro-meteorological parameters, morphology of river systems, neo-tectonism (Seismictly), over siltation and deforestation of the source area constitute the major factors influencing the floods of North Bihar. The channel pattern related to flooding are characterised as (i) increasing width-depth ratio (ii) increasing stream power, and (iii) increasing sediment load. In an attempt to control the flood the construction of embankments on both banks of North Bihar rivers have remained a major part of environmental expenditure. this has changed the natural morphological setting of rivers and thereby curb the translatory tendency of rivers. Spilling through gaps in the embankments enhanced with synchronisation of floods within adjacent basins magnifies the problems. The embankments have interferred with the natural processes of rivers and even in areas protected from spilling by them, there is waterlogging and salinity.

CONTROL MEASURES :

Alternative to construction of embankments include :–

(i) Upstream storage and construction of detention basins within the flood plains.

(ii) Artificial draw down of ground water.

(iii) Afforestation in the catchment area to be able to hold more run-off and check on dislodging of silt.

(iv) Flood proof planning with the support of preparation of Flood Risk Map, constituting the data on synthesis of rainfall, run-off, flood boundaries and

rehabilitation plan for different storming period over the base map of satellite image.

(v) Extending guidelines for flood control measures, based on above excersise, for minimising flood damage.

SEISMICITY :

Earthquakes of Bihar may be placed in two categories, one related to the earth movements of Himalayan frontal region and the other originating from stress fields built up in the northern front of Chotanagpur plateau. In recent past the Bihar-Nepal earthquake on 15-1-1934 of magnitude 8.1 continued through 19-1-1934 and with lower frequency till 13-4-1934. The main shock was felt over a large area of 4.72 million sq. km with a death toll of 7253. A prominent effect of the earthquake was a creation of major slump in the central part of the Ganga basin in which the tilting of houses and subsidence of ground was marked. The belt runs WNW-ESE for some 300 km from the Champaran district in the west through Muzaffarpur and Darbhanga districts to as far as Purnea in the east. The isoseismal X and IX (Mercalli) define two distinct tracks of the greatest damage : (i) a belt of 32 km wide trending ESE-WWW for some 128 km from east of Motihari through Sitamarhi to Madhubani (isoscismal X) and (ii) a narrow linear belt extending from Munger to Patna towns covering some 1300 sq. km (isoscismal X and IX).

Two other events i.e., on 16-8-1833 and on 31-8-1988 of high intensity have shaken the same geographical extent as the 1934 event. The former is assigned a magnitude of 7.5 < to < 7.9 and an epicentre close to Kathmandu within or close to the infered rupture zone of the 1934 event. The latter has an instrumentally determined magnitude of 6.4 and a depth of focus of 17 km. The damage areas of the earthquake are more or less same as that of for the 1934 event, the maximum intensity of IX and VIII was recorded in the northern part of the Madhubani and Darbhanga districts. A narrow E-W belt around Munger recorded damages of an intensity of 8 and 7.

The knowledge of the physical nature of earthquakes and their influences on engineering structure is essential for working in the zones where the occurrence of earthquake is probable. As a part of minimisation of damages and protection of life and property in the area already discussed, the following two management plans are suggestsed :

(i) to establish the nature of risk that would be if the planned structure is built in the given area. It further incorporates two considerations (a) seismicity of the region in terms of their intensity and magnitude and (b) the possible nature and consequences of earthquake damage to the particular structure.

(ii) to establish certain bases of structural design in seismic regions. These result from theoretical studies and actual observations of the ground motion and damage during an earthquake.

5.2 LAND DEGRADATION :

Soil Alkalinity : Salinity problem usually arise from (i) either through the use of saline waters for irrigation or (ii) through over irrigation and a consequent rise of a saline water table to the root, the irrigation of level lands which may be initially non-saline and well drained under natural conditions, but may have drainage facilities inadequate to take care of the additional groundwater resulting from irrigation practices may lead to develop alkaline soil. In such situations the grounwater level may be raised to the root in a relatively short time. Water then moves to the soil surface s a result of evaporation, increasing the salt content of the surface soil and of the soil water and causing the development of saline and alkaline soil conditions.

In north Bihar there is a zone of alkaline soil about 40 km wide, North-South, covering Gopalganj, southern part of East champaran, northern part of Siwan, southern part of Sitamarhi, northern part of Muzaffarpur, parts of Samastipur, Begusarai, Darbanga and Saharsa districts. About 80% of the affected area falls under the irrigational command area of Gandak and Kosi canals where the depth to water level varies from 2 to 5 m. below ground level during post monsoon and from 2 to 5 metre below ground level in selected patches and in eastern part and in general 5 to 10 below ground level during pre-monsoon period.

There are slected rich patches where (i) Salt peter (Sodium Nitrate and Potassium Nilrate) and (ii) ‘Reh’ (sodium carbonate, Sodium Sulphate and Sodium chloride) are found to occur. It has been usually found that in the dense populous area combined with warm-humid climate provides the favourable ground for formation of saltpeter. In the area near to village generates ammonia and nitrogenous substances. Bacteria comes into play and

transforms the decomposed substances into nitric acid. It reacts with the potassium salt of the soil and produces potassium nitrate.

In area north of Begusarai, near Majhaul, the aquifer lying at > 170 metre below ground level contains chloride value > 500 mg/L and the irrigational water utilised from this depth range increases the soil alkalinity.

The concept of total soil-moisture stress – a summation of osmotic pressure of the soil solution and the soil moisture tension, has since been used extensively and provided a firm basis for irrigation technology for handling the salinity problem.

WET LANDS :

The floodplain areas of Gandak, Burhi Gandak and Kosi rivers bear the record of various kinds of lakes, swamps and bogs. One of the common type is the oxbow lake, which is an abandoned meander loop of a river. Another type is produced during flood stage when natural levee form a dam between the main channel and the floodplain, creating a very shallow saucer-shaped basin. Other elongate lakes on flood plains are merely channels of master stream which are abandoned as it shifts its course in any manner. Such lakes are common along meandering rivers and are known as meander scrolls. In course of dynamic system of life history of a lake a bog is the end stage. It is characterised with a floating vegetal mat attached to shore. A swamp, on the other hand, is a vegetated land area saturated with water.

The lakes of north Bihar have provided food, primary water supply, fisheries, bird sanctuary for birds and supported base for aquatic bio-diversity. They have potential for recreational activities and tourism also. The Baraila Tal and Kanwar Tal are of prime importance. The wet-land zones are spread in north Bihar plains in sporadic patches and covers the parts of Paschim Champaran, Purbi Champaran, Sitamarhi, Muzaffarpur, Vaishali, Begusarai, Darbhanga, Supaul, Madhepura, Purnia, Kishanganj and Araria and in south Bihar the Mokamah Tal and Surajgarha Tal are worth mentioning.

Significance of Wetlands :

(a) According to Hollies et al 1988, wetland represents the transition from upland to deep water aquatic system and so they are actually ecotones having conditions

suitable for high diversity and productivity.

(b) Wetlands regulate the hydrological cycle by regulating the recharging and discharging of ground water.

(c) The help to maintain the quality and quantity of water by utilising the water purifying efficiency of plants and animals i.e. they serve as waste water treatment and oxidation ponds.

(d) Wetlands are the natural habitat for many fresh water and endangered species of plants and animals i.e., they serve as a valuable biogenetic pool.

(d) Wetlands are the natural habitat for many fresh water and endangered species of plants and animals i.e., they serve as a valuable biogenetic pool.

(e) They check the movement of nutrient and thereby ensure the efficient functioning of the physical, chemical and biological cycles of nature.

(f) Wetlands serve as storage reservoir of energy and carbondioxide.

RIVER EROSION :

River bank erosion under the influence of Ganga channel warrants serious attention as many times it remains the cause of concern for life and property. At all points enumerated below Ganga river by constant land erosion through breaking away and detachment of bank by the river waves or toe-erosion, are actively operative.

Sl. No.	Location of the Site
1.	Near Dighwara
2.	South of Bachwara
3.	South east of Begusarai
4.	South of Sahebpur Kamal
5.	South of Bihpur
6.	South east of Kursela
7.	West of Manihari

SILTATION:

The Gandak-Kosi interfan has been divided into an upper area of gently converging rivers that flow SE or south, perpendicular to the mountain front and a down stream area where the more sinuous channels of Burhi Gandak, Bagmati, kamla and Balan system flows gently to SE. The upper area surfaces composed of Gandak and Kosi megafans are yielding over the time the silt as reworked sediments as fine silt and causing enormous siltation in river channels and floodplains. Similarly, in the central Bihar Plain the sector between Jehanabad and Munger is having subsidence activity thereby the phenomenon of siltation is more pronounced.

The sediment yield can be reduced in the channel load and floodplain by some effective scientific and hydrological land treatment measures.

1. **Vegetative system :** Vegetation cover around the yield area exposed for erosion may reduce the inflow velocity of run-off and carrying capacity. The deposition of sediments can be enhanced in the upstream area by construction of diversions in the delta areas to develop better distribution of incoming floodwaters and deposition in the backwater areas.

2. **Watershed structures :** Several types of structures may be built in the watershed for the specific purpose of reducing sediment yield in the floodplain. These include such structures as sedimentation basins to trap sediment below eroding areas and erosion control structures to halt the production of sediment.

3. **Watershed Land Treatment Measures** : In case of primary source of sedimentation i.e. sheet erosion, land treatment measures provide an effective and economical means of reducing erosion and sediment yield.

4. **Site specific measures** : In case of low yield small dams may be placed across the yield area and the same may be excavated, mechanically, from time to time.

5.3 BIO-DIVERSITY LOSS :

The rich variety of flora and fauna we have around us is part of our natural heritage,

and we have to ensure that human activities do not spoil this great diversity and leave a poorer biosphere for the next generation. One way is to monitor the species diversity of ecosystems that are subjected to the ravages of human influences such as pollution and deforestation. An important feature of the ecosystem is the diversity of organisms within it, under stress, natural or man made, the species diversity decreases. Greater diversity and abundance indicates the well being of an ecosystem.

In Bihar only 7% of the area is under forest cover. Due to lack of density of forest the bio-diversity has tremendously reduced. Mainly, two variety of monsoon dependent forest viz; Humid deciduous forest and dry forest and one related to sub Himalayan and Tarai affinity forest are found in Bihar. The first type is found in and around Kishanganj district, the second type is prevalent in the Kaimur district and others sporadic spread sporadially along the northern slope of Chotanagpur plateau. The third type is found around the Someshwar hills in Paschim Champaran district.

For the purpose of wild life protection following sanctuaries, national parks and protected areas have been identified:

1. Bhim Bandh Wildlife Sanctuary, Munger;
2. Gautam Budha Wildlife Sanctuary, Gaya;
3. Kaimur Wildlife Sanctuary, Kaimur;
4. Pant Wildlife Sanctuary, Nalanda;
5. Valmiki Wildlife Sanctuary, West Champaran;
6. Kanwar Lake Bird Sanctuary, Begusarai;
7. Kushewhwar Sthan Bird Sanctuary, Darbhanga;
8. Salim Ali Jubba Sahni Bariela Jheel Bird Sanctuary, Vaishali;
9. Vikramshila Gangetic Dolphin Sanctuary, Bhagalpur;
10. Nagi Bird Sanctuary, Jamui;
11. Nakti Bird Sanctuary, Jamui;
12. Udaipur Wildlife Sanctuary, West Champaran;
13. Valmiki National Park, West Champaran; and

14. Sanjay Gandhi Biological Park, Patna.

For the effective maintainence and long term preservation of these sanctuary it is essential to examine the contemporary Environmental Impact Assessment (EIA) in order to schedule the future Environmental Management Plan (EMP).

5.4 WATER IMBALANCE :

Bihar is still in its infancy in the development of groundwater management. The question of the management of groundwater for irrigational purposes, it is essential to consider many vital economic and scientific aspects and the possibility of conjunctive use of both surface and ground water for the purpose. The various stages are enumerated bleow :

A. Selection of areas on the basis of availability of reserves of groundwater and the limits to which they can be withdrawn.

B. The actual tube-well sinking should be based on scientific and economic principles, as far as well assemblies, gravel shrounding, screen selection and aquifer selection are concerned; pump design should also be based on water requirement; this, in turn, should be the deciding factor for the thickness of aquifer to be tapped;

C. Considering the surface water resources of the terrain and weighing the posoibility of their conjunctive use with groundwater - Modification of existing surface water schemes and supplementing them with ground water etc.

D. Enforcing necessary legislative measures over jurisdiction and utilisation of water resources, to prevent unplanned tapping and weightage;

E. Agronomical and pedological aspects have to be considered to match the quality and quantity of water available with the cropping pattern.

5.5 URBANISATION :

The continuing growth and concentration of population and industry in urban and sub-urban areas in recent decades have caused a complex merging of social, economic and physical problems. The urban environment is one that requires an special planning and management, because once the development has been effected, roads laid, pipes installed, buildings in plac turning back would be a difficult proposition. Therefore, room for error cannot be afforded.

In the background of Bihar, majority of the township have come-up as agglomeration around the pre-existing nucleus without considerating the town planning measures and land-use patterns. To some extent the wastern part of New capital city of Patna has witnessed the town planning regulations. Some effective schemes with respect to sewage management, traffic and transport management have been made-effective.

As a first stage of amelioration of the process the concept of open space has become associated with the deliberate maintenance of natural area with and surrounding an urban area could be applied in the pre text of Bihar township. The open should be characterised with natural scenic beauty, or places necessary to help maintain the natural systems. It is on the opposite side of the spectrum where urban sprawl resides - the rampant and unrestricted growth of developed area. It can take several forms and is embraced under such related planing conditions as the green belt, new town, satellite township or garden city. Thus it serves a diversity of functions such as :

(i) Providing for resources production in forestry agriculture, natural resources and water supply;

(ii) Preservation of natural and human resources;

(iii) Provision for water and air quality and visual and recreational amenities;

(iv) Protection of public safety in hazard prone area ;

(v) Filteration of air-borne pollutants by vegetation;

(vi) helping to compensate for the heat island effect and micro-climate disturbances caused by the city ;

(v) For laying out the above proposal it is essential to plan the new township after the proper EIA and EMP survey.

5.6 MINING :

The far reaching effect of mining on physical as well as biological resource base are defacing landscapes, hydrological deterioration and air pollution.

(i) Defacing landcapes : The process of mining are of two types (i) Surface or open casting e.g., linestone, rock chips, tiles etc; and (ii) underground mining e.g., pyrite (Rohtas) and Mica (Nawada & Jamui districts). in both the cases, vegetation and top soil have to be removed to get access to the deposit. The area thus lost is increasing day by day. Dump disposal is another problem.

(ii) Hydrological deterioration : One of the most pronounce and long lasting effects of mining is qualitative and quantitative deterioration of water resources. Mining disturbs natural hydrological process and disrupts flow lines and utlimate storage of ground water.

(iii) Air Pollution : The SPM is increased in ambient atmosphere. In the area around Amjhor (Rohtas) sulphuric acid leachets have chances of getting mixed with groundwater.

The discharges coming out of mining to be monitored, treated and disposed at suitable site.

5.7 AWARENESS :

Awarness has a great role in the protetion of environment and conservation of natural resources. Ignorance and misconceptions among the large section of population also cause of environmental damage and pollution. Posistent and sustained efforts for creation of awarness on environment and ecology is need of the hour. The sunmmarised reasons, status and treatment aspect of awaraness is presented in Table 82.

TABLE - 82 : AWARENESS ABOUT ENVIRONMENT

(BY PRODUCT OF RAPID INDUSTRIALISATION DEVELOPMENT PROJECTS)

A

CAUSE OF IGNORANCE

1. The curriculum for medicine, engineering, technology, agriculture, economics or development has no blending component of environmental matters
2. Planner or policy makers are not trained to foresee the environmental consequences of their decisions.
3. Opinion leaders, often, conceal information from public or mislead them for their own reasons
4. Business or industry owners are guided entirely by considerations of economic gains to themselves

MISCONCEPTIONS

(i) Diseases caused by demons or Gods.
(ii) Famies, drought or floods-punishment by God.
(iii) Rainfall-Gods grace
(iv) Cities are polluted whereas villages are not .
(v) Automobile exhaust in cities are not polluted
(vi) Forests are disappearing due to industrialisation and urbanisation but not due to fuel wood cutting
(vii) Lack in hierachy of responsibility ownership.

NECESSITY

For environmental information arising out of :
(i) Food Production,
(ii) Enhanced ways of earning livelihood,
(iii) Effect of technology,
(iv) Impact of all dovelopmental activities on health.

e.g.;
(a) Agriculture : Land use pattern, water resources irrigation pattern & issue of social awareness
(b) Industry : Increased waste & pollution, cost of pollution
(c) Health : Urbanisation, high incidence of diseases due to lack is health determinant factors, malnutrition

(v) Disciplined human decision i.e.; general welfare, fixation of responsibility for degradation and amelioration, consciousness about unadable effects due to environmental encroachment and environmental law implementation.

B

ENVIRONMENTAL INFORMATION DESSEMINATION

A. Among Students through education :
B. Among General population through various media :
(i) Incorporation of topics in regional languages-adult education programme.
(ii) Information packs like posters, slides and audio visual material
(iii) Special exhibition is rural areas at the time of fairs and festivals.
C. Among opinion leaders : e.g., Govt. officers, voluntary organisations, politicians & social workers and functionaries concerned with critical decisions should have orientation and training.

NGO'S ROLE

Role :
(i) to aid and advice the government
(ii) to act as the eyes and ears of the Govt. and
(iii) to educate the people at large and to creat general awareness in favour of conservation.

Action :
(i) Preparation of database,
(ii) Formation of action group
(iii) Act as pressure group,
(iv) Advise the govt. on legislation,
(v) Undertake education activiity,
(vi) Research on specialised issue and
(vii) Bring out useful publications.

Stage	Objective	Content	Teaching Strategy
Primary	Awareness	Surrounding from home to outdoor situation	Audio-visual and field visits
Lower Secondary	Real life experiences, awareness and problem indentification	As above and general science	Classroom teaching, practicals and field visits
Higher Secondary	Conservation, assimilation of knowledge, problem identification and action	Science based and Action oriented work	Classroom teaching, practicals and field work
Tertiary / College	Sustainable development based on experience with Conservation	College/University based on science and technology	Classroom teaching, practicals and action oriented field work

[152]

CONCLUSION AND RECOMMENDATIONS

1. The state of Bihar may be broadly divided, on macro scale, into northern and central Ganga plains and the southern most part of plateau region of which the Chotanagpur plateau is most prominent alongwith minor Kaimur plateau. The north-western part is covered with Himalayan foothills. Any step to revive the economy of the state warrants interlinkages between environment and development issues within the framework of macroscale zonation, as outlined above.

2. Environment being a cross sectoral issue, concerning many departments, agencies and public participation it becomes mandatory to capture and elicit view points of all concerned government agencies and NGO's engaged in this sector.

3. The consultative process covering NGO's, civil society representatives and general public to express their environmental concerns and priorities needs to be adequately attended to be able to refine this report into an Environment Monitor, highlighting the key issues, hotspots and priorities.

4. A data-bank system needs to be created to systematically collect, collate and synthesise information from various sources, on Geographical Information System (GIS), to assess the incidence and magnitute of environmental degradation on multi-temporal, multi sectoral and multi bio-physical facies. This Monitor system could be utilised as a basis for further stakeholder consultations to develop an Environmental Action Plan for Bihar. A cell equipped with hardware & software relating to GIS / Remote sensing technology should be setup with a view to updating various data on regular basis.

5. The Monitor's Primary target is to create awareness among the NGO's, general public and other concerned stakeholders, who may utilise the information generated out of data-bank system to initiate appropriate actions in their region of concern through inter and intra sectoral co-ordination.

6. The State Government should prioritise in its agenda training programmes for raising trained manpower for environmental protection including Wild Life Management and Forest Protection.

7. A survey of ecological habitat, including collection of information relating to wetlands of the State for the protection of Environment and Conservation of Medicinal and Herbal Plants, which are in the process of being extinct in the State of Bihar, should be initiated on priority basis.

8. Ex-situ protection methods of conservation like Tissue Culture and Bio-technology should be brought into the State's agenda, so as to preserve the endangered species of flora and fauna.

9. Public participation should also be encouraged in the forest protection and its management, so as to develop and maintain a complementary relationship with forests.

10. Grazing by domestic animals inside forest should not be allowed, so as to protect wild animals from diseases and other related problems.

11. Botanical Gardens with special reference to medicinal plants should be developed in different areas of the state.

12. To conserve water resources, effort under National River Conservation Plan, to study the effects of pollution on surface water, including changes in the technology for recycling domestic wastes should be taken up. Interlinking of various rivers of Bihar should be planned to use judiciously, the available water in various basins. This will further help in controlling floods and water logging.

13. Steps should be taken, if possible by special legislation, for Rain Water Harvesting, so as to conserve water resources.

14. Non-conventional and renewable sources of energy like Hydro, Wind, Biomass and Solar energy should be encouraged.

15. Approach of public-private-partnership should be adopted by the State towards environmental protection with special reference to industrial planning and development.

16. State should ensure installation of Common Effluent Treatment Plants (CETPs) for the industrial growth centers.

17. Common Bio-Medical Waste treatment facilities should be developed at least in each district headquarter of the State for the proper management of Bio-Medical Wastes generated in the district.

18. Bottlenecks at the main traffic intersections and roundabouts should be cleared.

19. Only light motor vehicles should be allowed to ply on the trunk road at peak hours. Public transport system should be planned for various towns in the State.

20. No drive days should be encouraged to reduce air pollution and energy conservation.

21. Indoor air pollution and health impact should also be assessed.

22. Studies on environmental degradation of hillocks due to stone mining in the state should be carried out. Environmental Management Plan should be prepared for stone and sand mining before the process of auction for grant of lease.

23. Possibilities for providing drinking water from surface water resources after treatment in place of underground water should be explored.

24. Urban Solid Waste Treatment Facilities should be developed in each municipal area for proper management of solid wastes. Urban Development Department should plan for Integrated solid waste management policy and programme on public - private partnership basis.

REFERENCES

Abbas, N. and subramaniyan, V., 1964, Erosion and sediment transport in the Ganga River Basin. Indian Jour. Hydrology, 69.

Abhasi, S.A., Environment Everyone, Discovery Publishing House, New Delhi

Base, P.K., Saikia, B.C. and Mukherjee, B.B., 1966, Refraction seismic survey for groundwater in Patna and Gaya districts, Bihar. Unpub. Rep., Geol. Surv. Ind, calcutta

Bandhu, Destri Environmental Management, Indian Environmental Society, New Delhi

Coleman, J.M., 1969, Estimates of annual sediment transport by the Ganga/Brahamaputra. Sediment. Geol. 3

Central Statistical organisation (1991 & 2001). Census of India, Govt. of India, New-Delhi

Handbook of statistics on State Government finances, 2001 Valdiya, K.S., 1987, Environmental Gelogy - India context.

Kumar, N., 1970, Bihar District Gazetters, Govt. of Bihar, Patna, Gazetters Branch, Revenue Deptt., Patna

Planning Commission (1997). Ninth Five Year Plan Document, Planning commission, Govt. of India, New-Delhi

Peavy, Howard S., etal; Environmental Engineering, Mc graw - Hill International Edition (Civil Engg. series), New york.

Roy, A.K. and Sinha, S., 1968, Groundwater resources of Bihar with special reference to the problems of planning and development for irrigation purposes. Unpub. Rep., Geog. Surv. Ind.

Reserve Bank of India 2001.

Rural Development Ministry Report, Govt. of India, 2001.

PLATE NO. 1

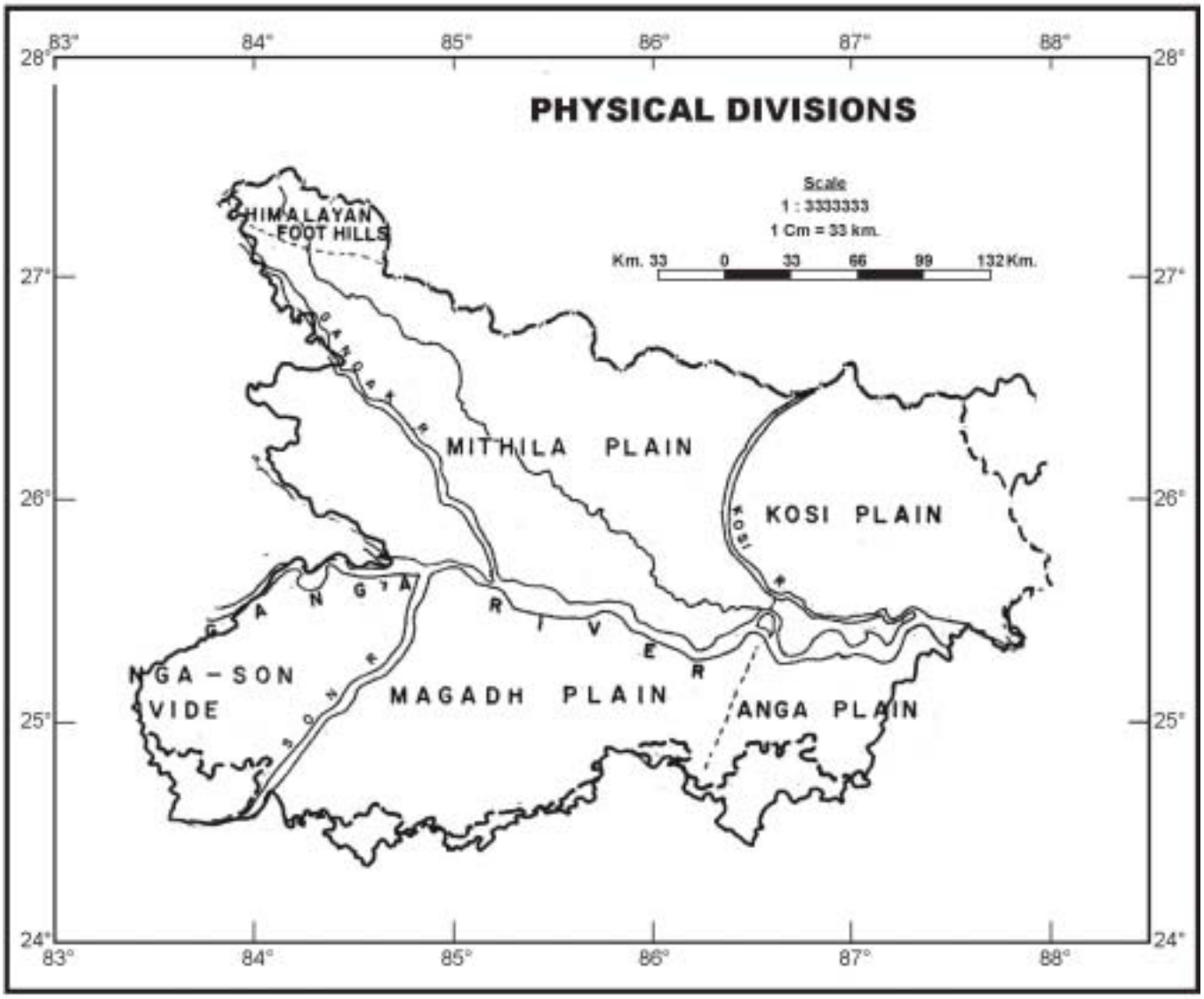
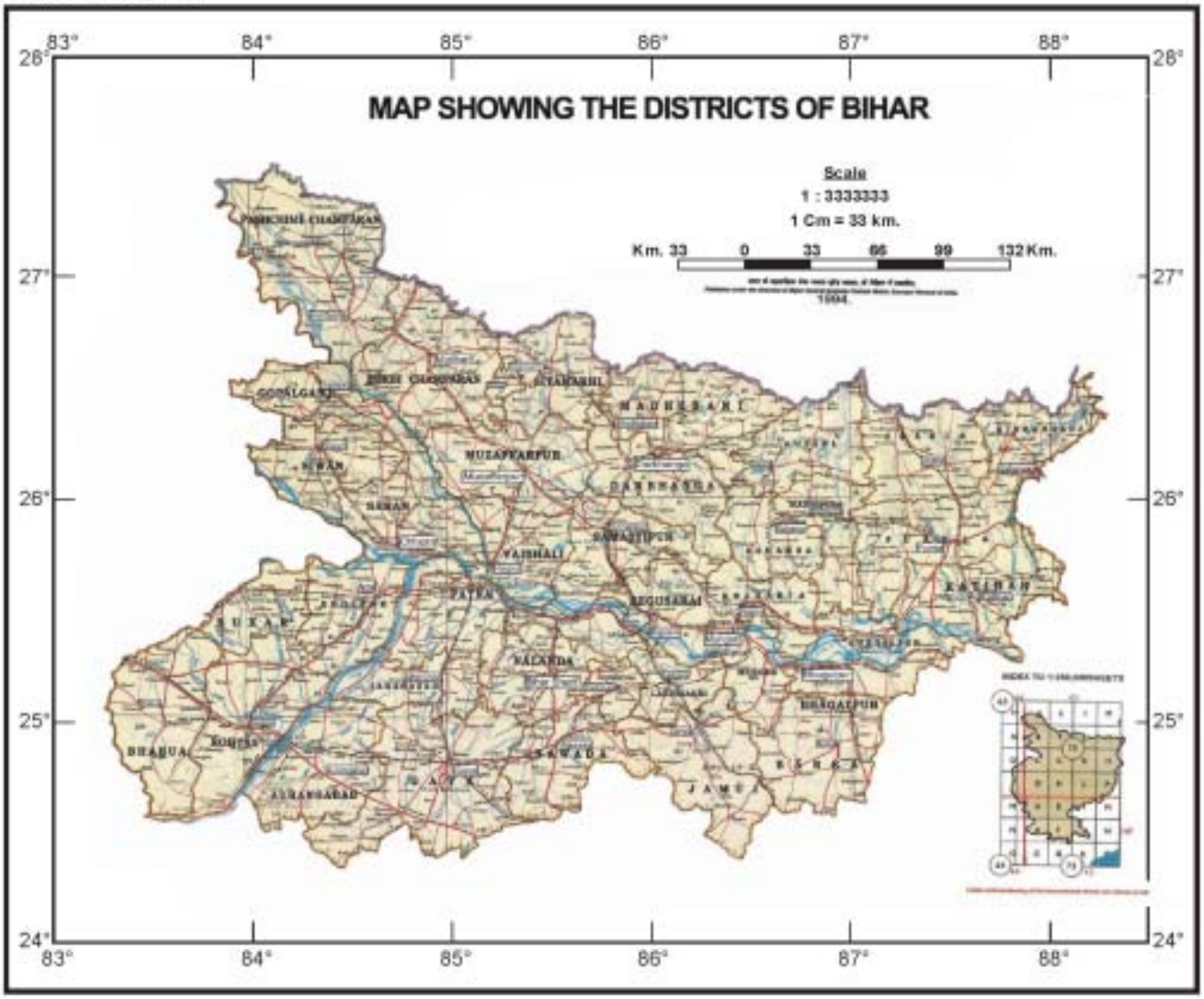

PHYSICAL DIVISIONS
Scale
1 : 3333333
1 Cm = 33 km.
Km. 33 0 33 66 99 132 Km.
HIMALAYAN FOOT HILLS
MITHILA PLAIN
KOSI PLAIN
MAGADH PLAIN
ANGA PLAIN
NGA – SON VIDE
83°
84°
85°
86°
87°
88°
28°
27°
26°
25°
24°

PLATE NO. 2



NAME OF DISTRICTS

PASCHIM CHAMPARAN	PURBI CHAMPARAN	SITAMARHI	MADHUBANI
SUPAUL	ARARIA	KISHANGANJ	GOPALGANJ
SIWAN	SARAN	MUZAFFARPUR	DARBHANGA
VAISHALI	SAMASTIPUR	SAHARSA	MADHEPURA
PURNIA	KATIHAR	KHAGARIA	BEGUSARAI
BHOJPUR	PATNA	MUNGER	BHAGALPUR
KAIMUR	ROHTAS	JEHANABAD	NALANDA
AURANGABAD	GAYA	NAWADA	JAMUI
BANKA			

PLATE NO. 3

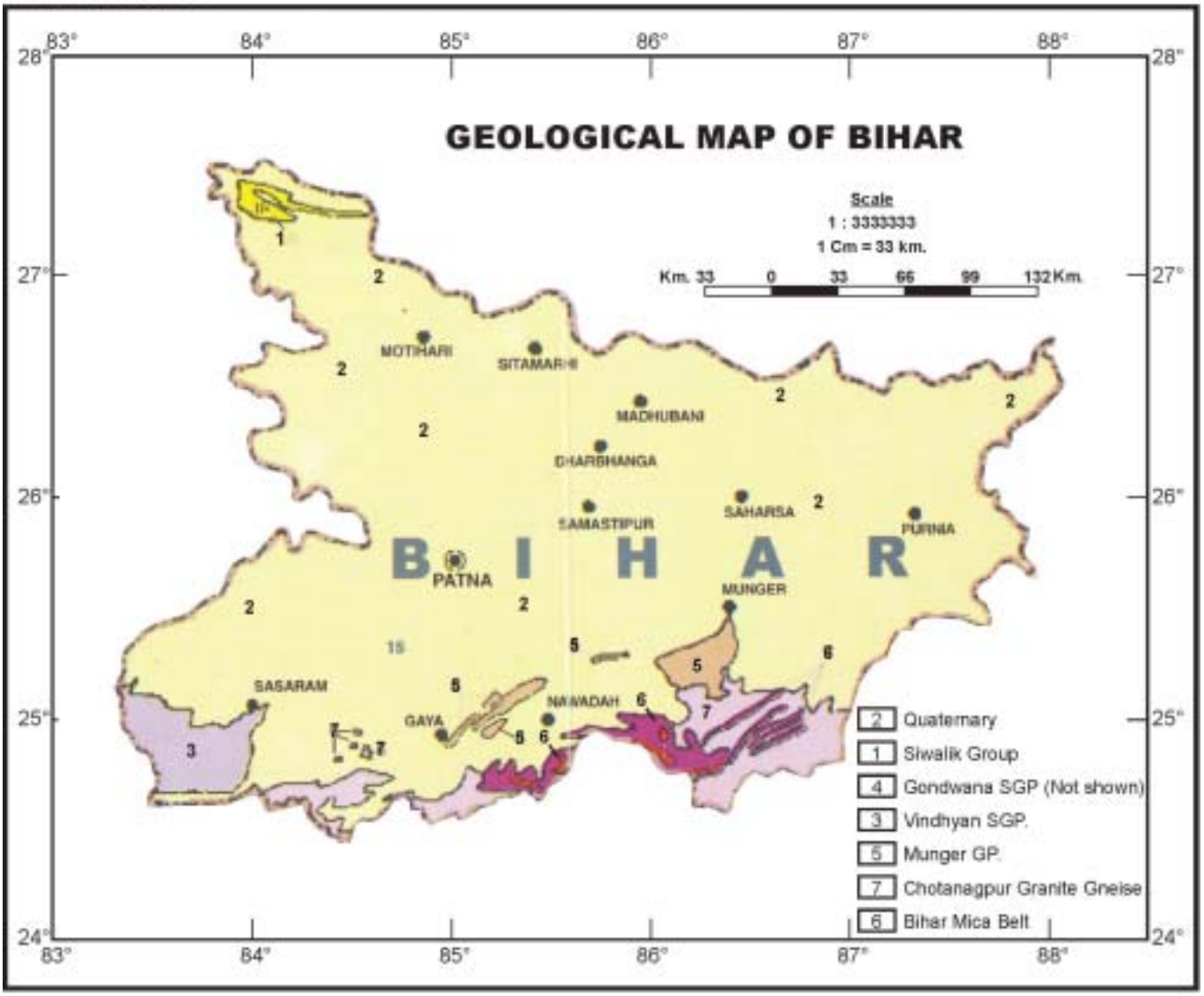
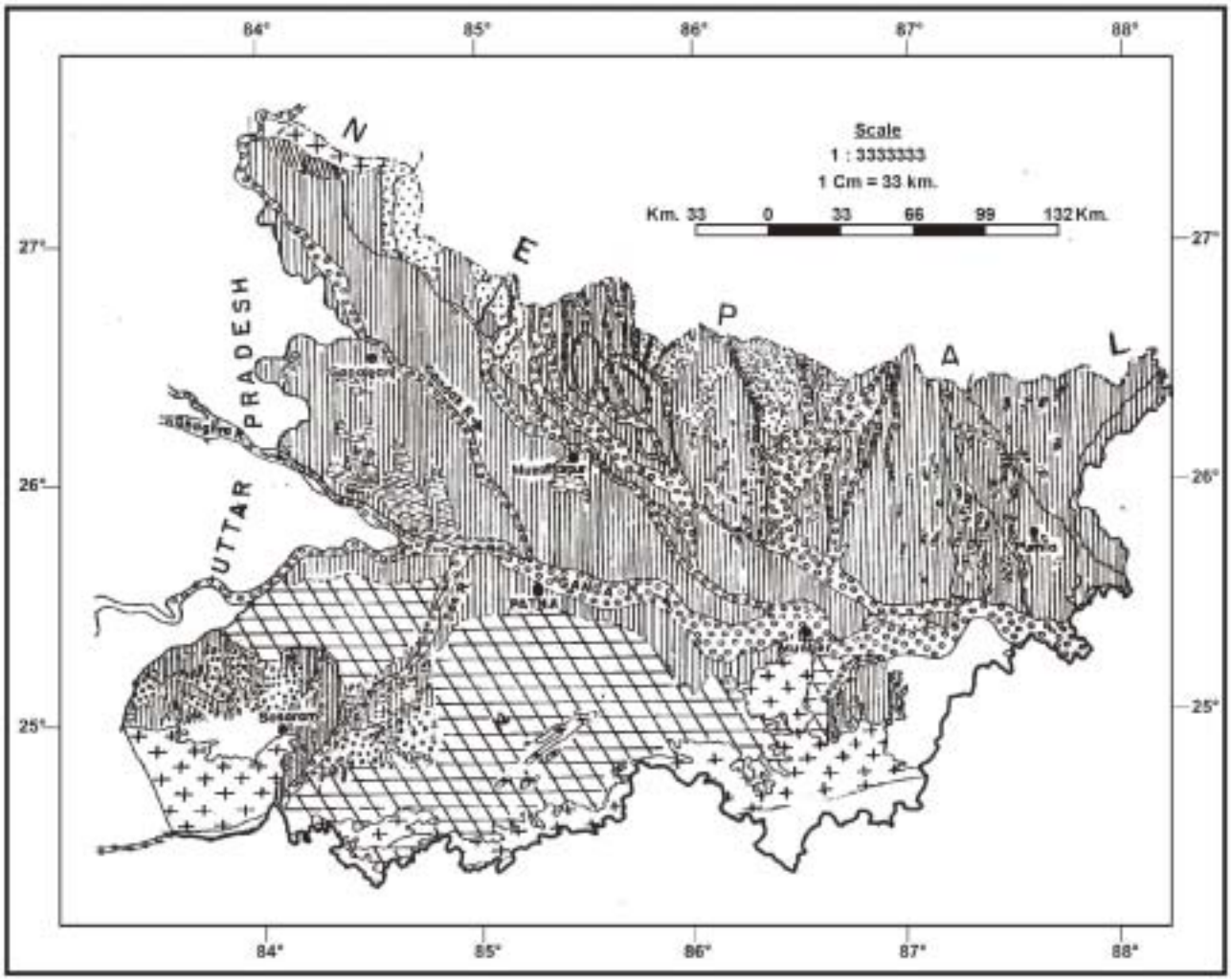

GEOLOGICAL MAP OF BIHAR
Scale
1 : 3333333
1 Cm = 33 km.
Km. 33 0 33 66 99 132 Km.
83°
84°
85°
86°
87°
88°
28°
27°
26°
25°
24°
BIHAR
PATNA
MOTIHARI
SITAMARHI
MADHUBANI
DHARBHANGA
SAMASTIPUR
SAHARSA
PURNIA
MUNGER
SASARAM
GAYA
NAWADAH
2 Quaternary
1 Siwalik Group
4 Gondwana SGP (Not shown)
3 Vindhyan SGP.
5 Munger GP.
7 Chotanagpur Granite Gneise
6 Bihar Mica Belt

PLATE NO. 4

QUATERNARY GEOLOGICAL MAP OF THE LOWER GANGA BASIN, BIHAR



EXPLANATORY LEGEND

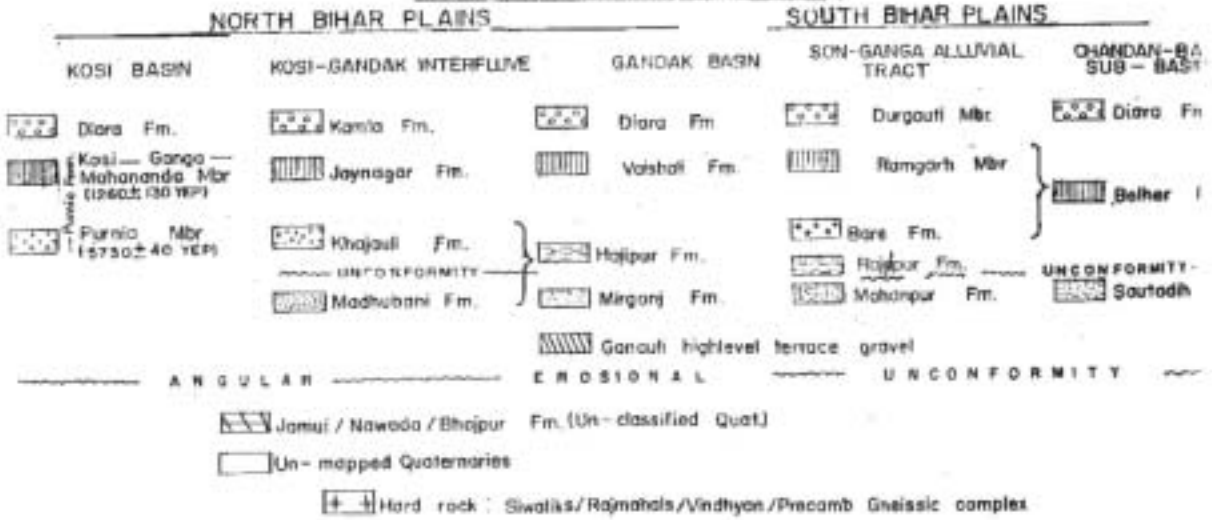


PLATE NO. 5 (A)

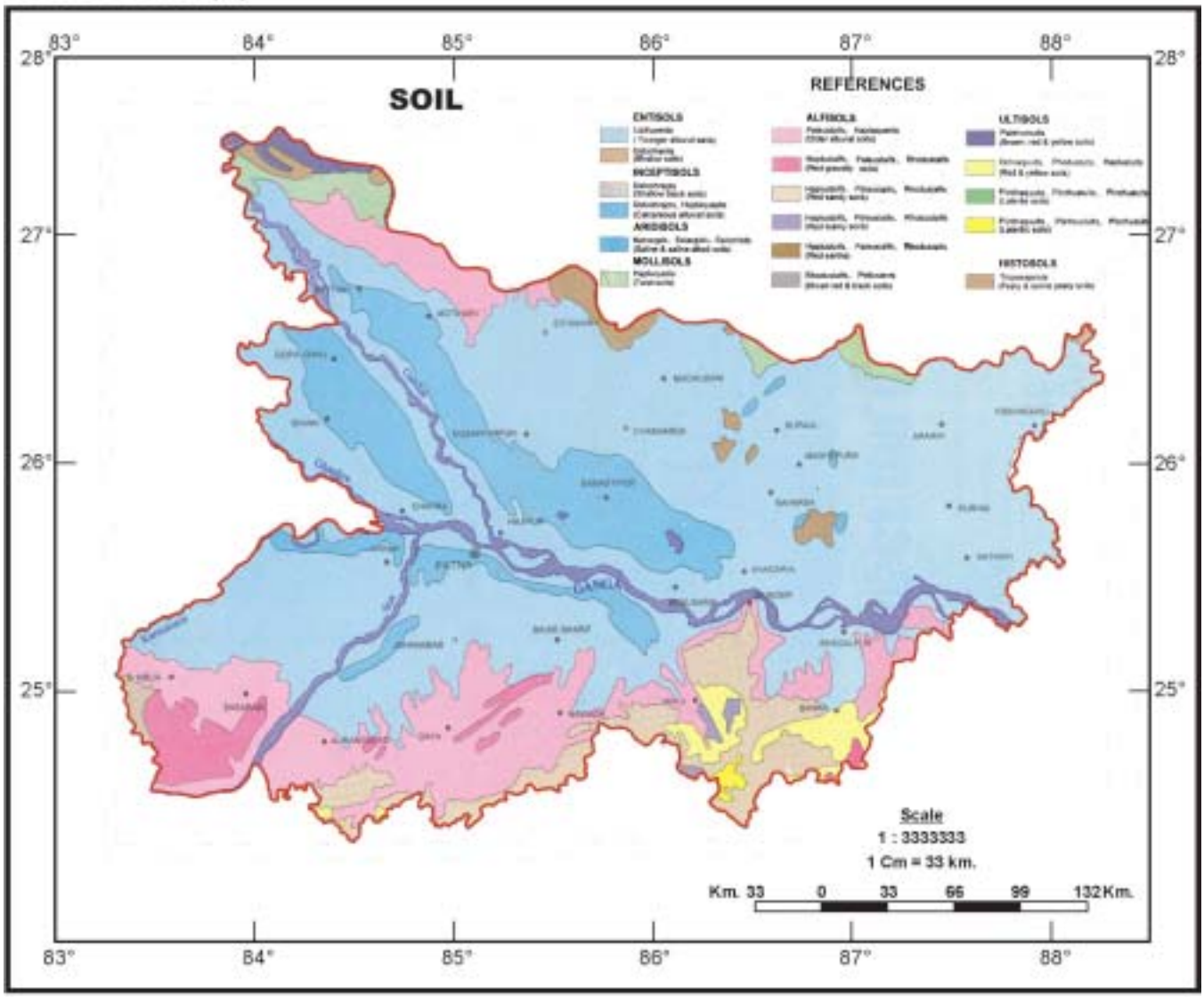
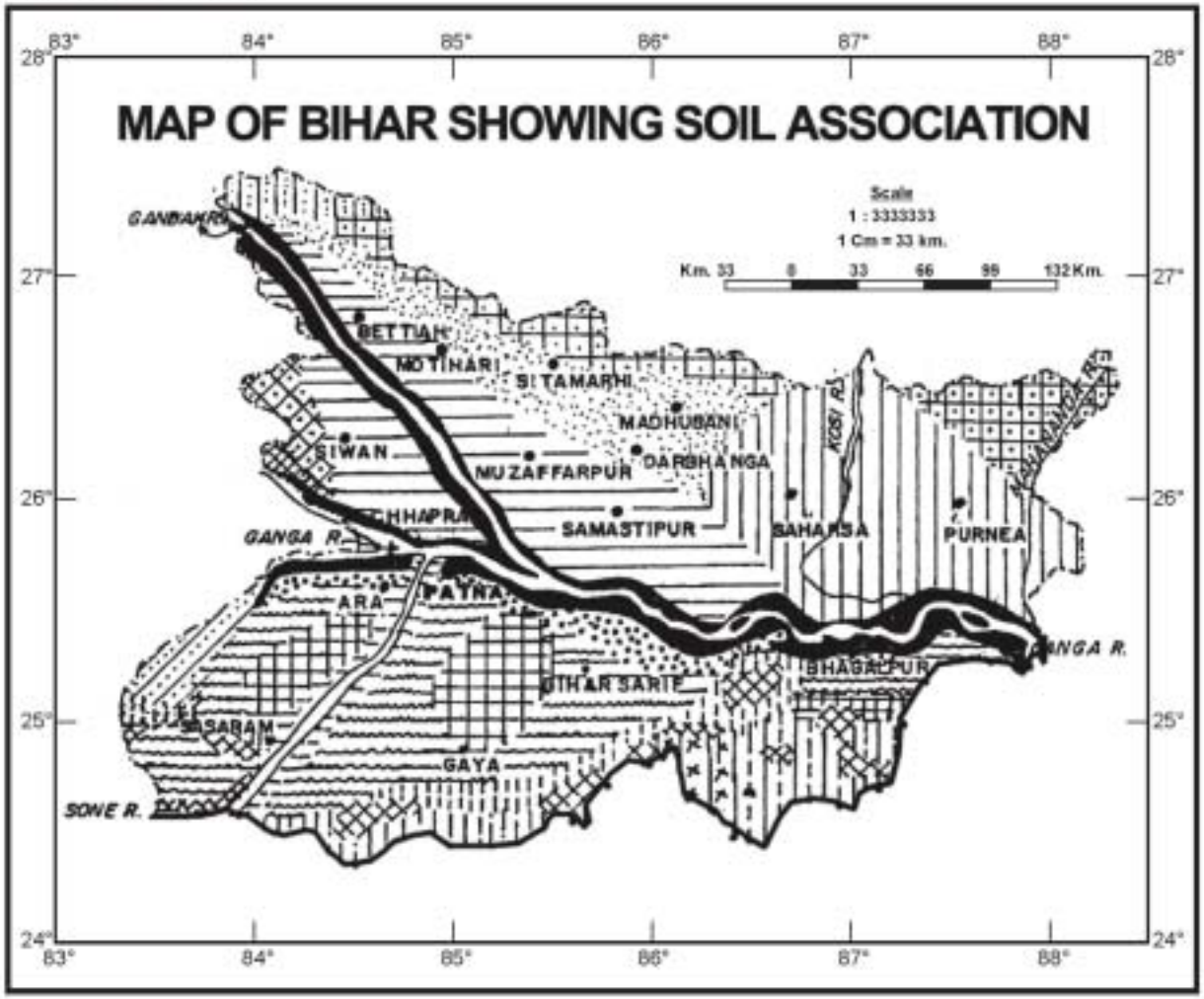

SOIL
REFERENCES
ENTISOLS
INCEPTISOLS
ARIDISOLS
MOLLISOLS
ALFISOLS
ULTISOLS
HISTOSOLS
83°
84°
85°
86°
87°
88°
28°
27°
26°
25°
PATNA
GANGA
Scale
1 : 3333333
1 Cm = 33 km.
Km. 33 0 33 66 99 132Km.

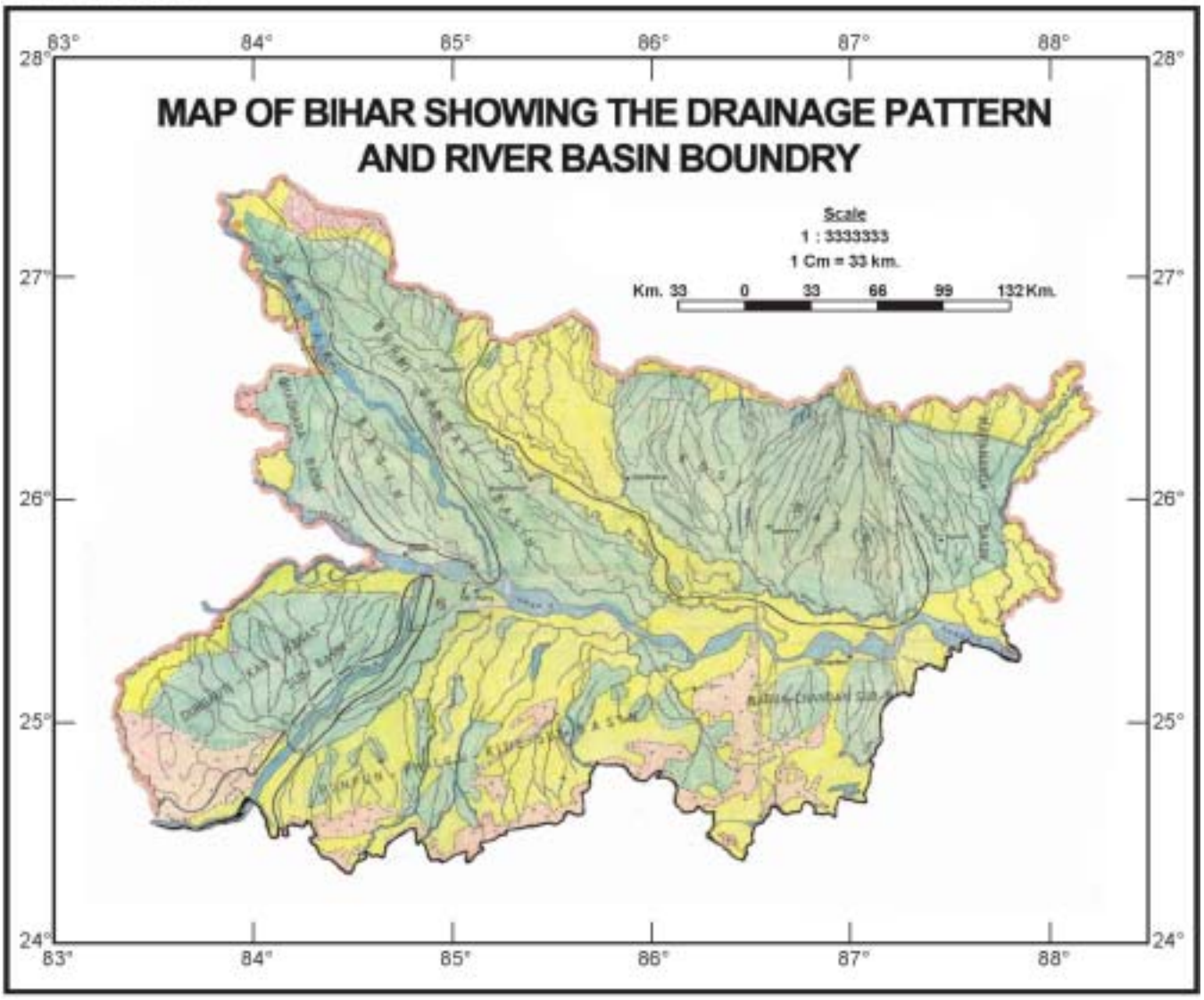
PLATE NO. 5 (B)



LEGEND OF BIHAR SOILS

1. SUB-HIMALAYAN HILL AND FOREST SOILS
2. RECENT ALLUVIUM-TARRAI SOILS
3. RECENT ALLUVIUM-NONCALCAREOUS NON SALINE
4. YOUNG ALLUVIUM-NONCALCAREOUS NONSALINE
5. YOUNG ALLUVIUM-CALCAREOUS (WITH PATCHES OF SALT AFFECTED SOILS)
6. YOUNG ALLUVIUM-CALCAREOUS SALINE-SALINE ALKALI
7. NON-CALCAREOUS-ALLUVIAL SOILS
8. RECENT ALLUVIUM CALCAREOUS
9. RECENT ALLUVIUM-YELLOWISH TO REDDISH-YELLOW NONCALCAREOUS NONSALINE
10. TAL LAND SOILS-LIGHT GREY-DARK GREY-MEDIUM TO HEAVY TEXTURED SOILS
11. OLD-ALLUVIUM-GREY-GREYISH YELLOW-HEAVY TEXTURED SOILS WITH CRACKING
12. OLD-ALLUVIUM-REDDISH YELLOW-YELLOW GREY CATENNARY SOILS
13. OLD-ALLUVIUM-SALINE AND SALINE ALKALI SOIL
14. OLD-ALLUVIUM-YELLOWISH-RED-YELLOW SOILS OF FOOT HILLS
15. HILL AND FOREST SOIL OF STEEP SLOPES AND HIGHLY DISSECTED REGION
16. RED-YELLOW-LIGHT GREY CATENARY SOILS
17. YELLOW-REDDISH YELLOW MEDIUM DEEP-LIGHT TEXTURE CATENARY SOILS
18. PALE YELLOW-YELLOW-PINKISH DEEP CATENARY SOILS ON MICACEOUS SCHISTS
19. REDDISH YELLOW-YELLOW-GREYISH YELLOW DEEP CATENARY SOILS ON COAL BELT
20. UPLAND GREY-YELLOW-GREY-HEAVY SOILS ON SEDENTARY AND ALLIED ROCKS
21. YELLOW RED-YELLOW-BLACK CATENARY SOILS ON RAJMAHAL TRAP ROCKS
22. RED-YELLOW-CHOCOLATE SOILS OF IRON-ORE REGION
23. MIXED RED-YELLOW BLACK CATENARY SOILS OF SINGHBHUM
24. RED-YELLOW-GROUND WATER LATERITE SOIL

PLATE NO. 6



INDEX

- Hard Rack Area
- Soil / Alluvium / Colluvium / Regolith
- River Basin Bondary
- Water Body
- Irrigational Command Area

PLATE NO. 7 (A)

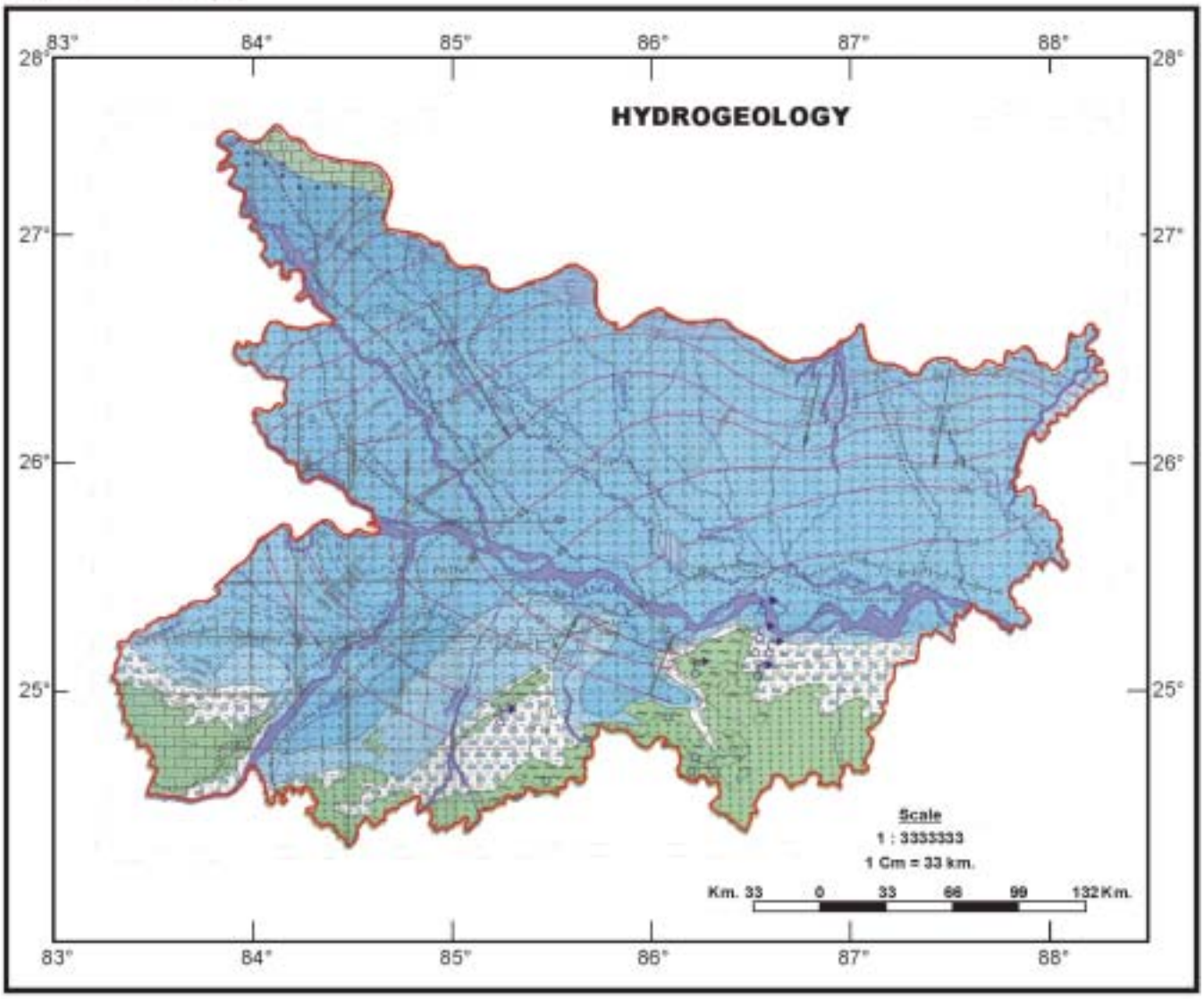
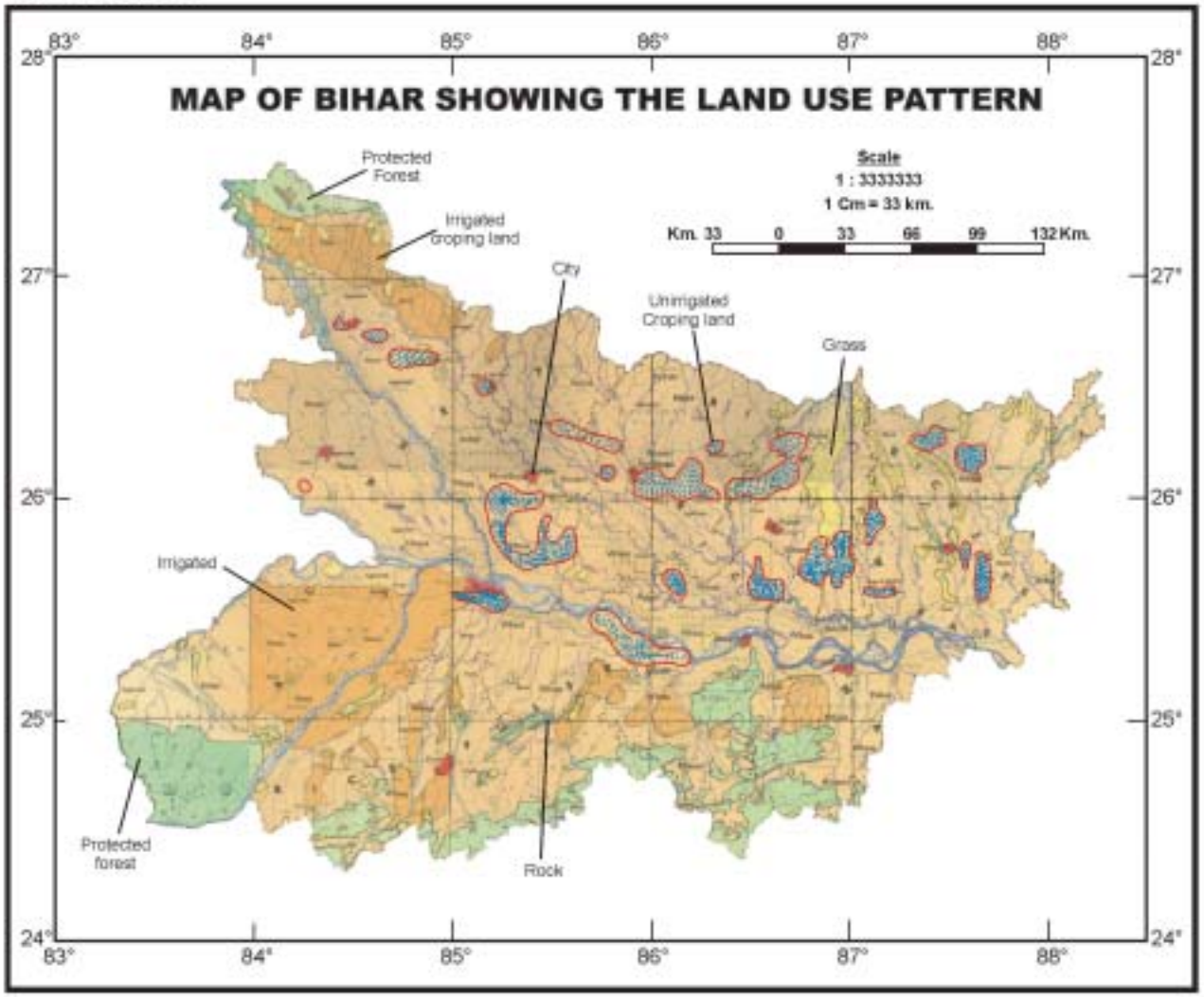

HYDROGEOLOGY
83°
84°
85°
86°
87°
88°
28°
27°
26°
25°
Scale
1 : 3333333
1 Cm = 33 km.
Km. 33 0 33 66 99 132 Km.

PLATE NO. 7 (B)

LEGEND

	AGE GROUP	LITHOLOGY	HYDROGEOLOGICAL CONDITIONS	GROUND WATER POTENTIAL
			POROUS FORMSATION (unconsolidated and Semi consolidated)	
UNCONSOLIDATED FORMATIONS	Quaternary Upper Tertiary	Recent alluvium, Clay, Silt, Sand, Gravel, Pebble, Calcareous concretion etc.	Fairly thick regionally extensive confined / unconfined aquifers down to 300m.	Large yield prospects Above 150m³ / hour
		Older alluvium and laterite, Silt, Sand, Ferruginous concretions, Lithomargic clay, Gravels, Pebbles, Cobbles etc.	Moderately thick and regionally extensive confined / unconfined aquifer down to 150m	Moderate yield prospects 50 to 150m³ / hour Moderate yield prospects 50 to 150m³ / hour
			FISSURED FORMATION (Consolidated)	
CONSOLIDATED FORMATIONS SEDIMENTARIES, META-SEDIMENTARIES, EFFUSIVES BASAL CRYSTALLINES	Tertiary Pre-Cambrian	Sandstone, Dolomite, Limestone.		Yield prospects Below 20 m³/hour
	Pre-Cambrian	Slate, Quartzite, Phyllite, Schist, Gneiss, Marble.		
			Groundwater restricted to weathered residuum fracture zone having secondary porosity	
	Archaean	Gneissic complex and associatated intrusive.		

PLATE NO. 8



REFERENCES

AGRICULTURAL LAND
- Irrigated crop land
- Unirrigated crop land
- Wet land

FORESTS
- Protected

NON AGRICULTURAL LAND
- City

GRAZING LAND
- Grass

UNPRODUCTIVE LAND
- Rocky

PLATE NO. 9

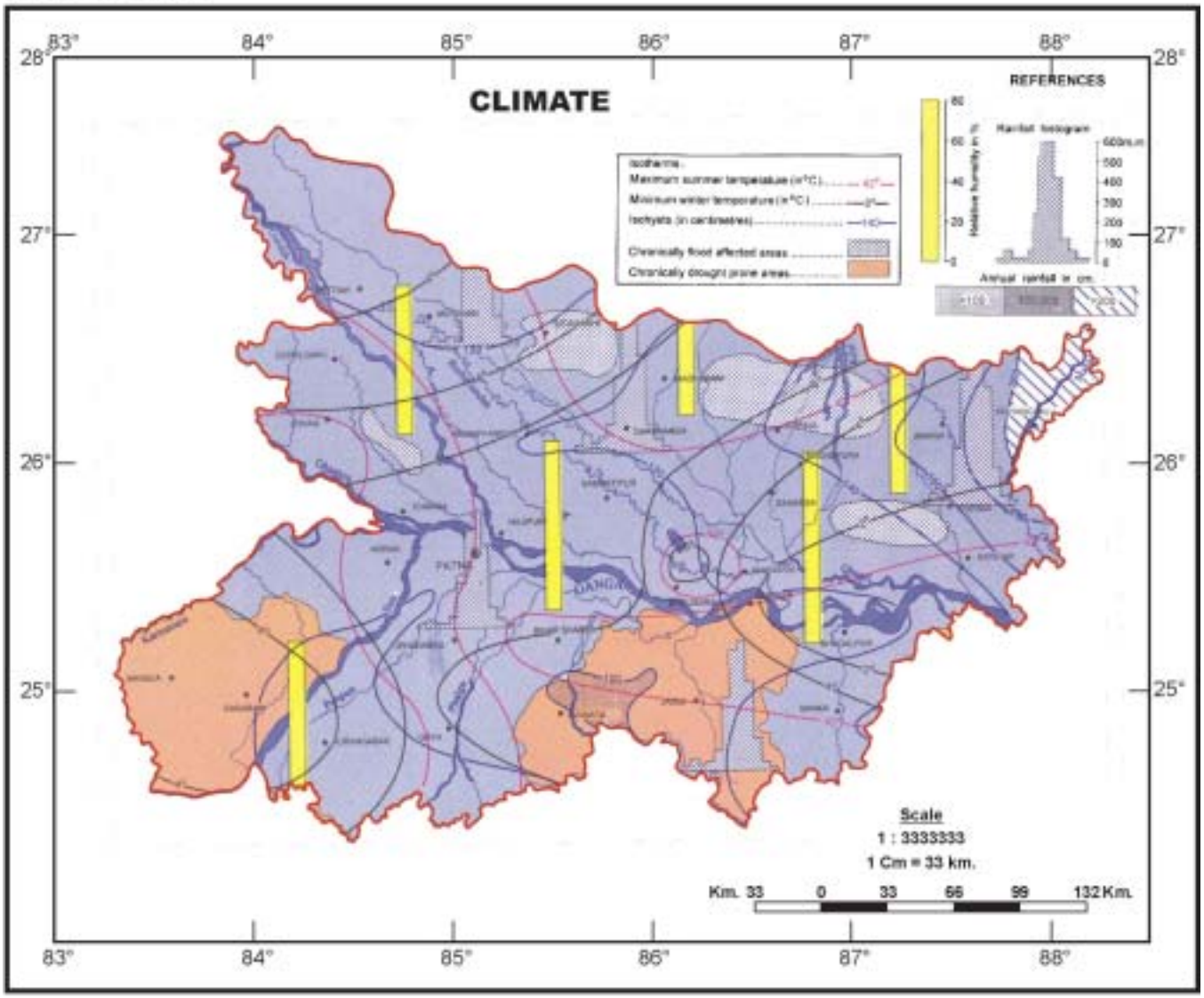

CLIMATE
REFERENCES
83°
84°
85°
86°
87°
88°
28°
27°
26°
25°
Scale
1 : 3333333
1 Cm = 33 km.
Km. 33 0 33 66 99 132 Km.

PLATE NO. 10

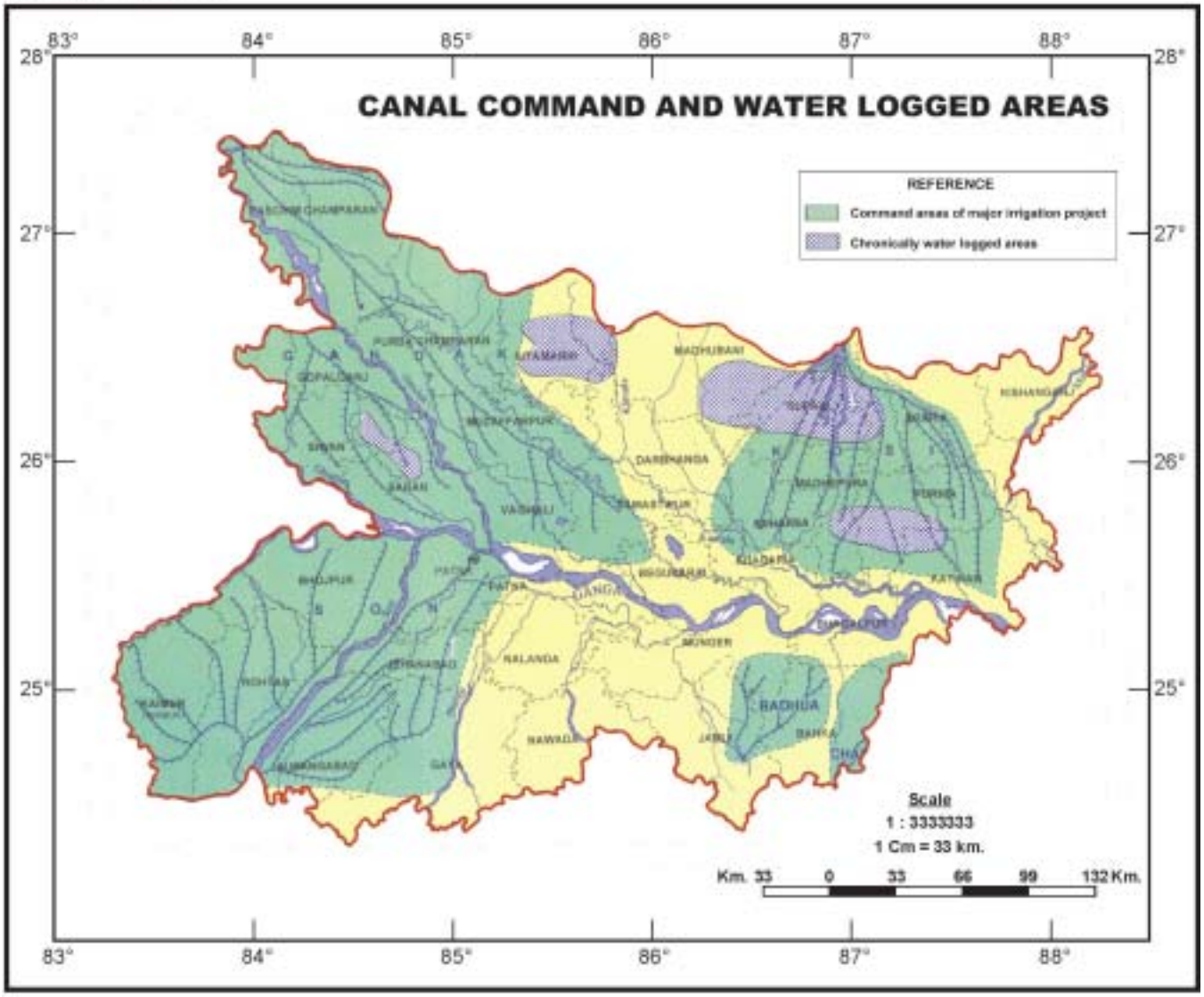

CANAL COMMAND AND WATER LOGGED AREAS
REFERENCE
Command areas of major irrigation project
Chronically water logged areas
83°
84°
85°
86°
87°
88°
28°
27°
26°
25°
Scale
1 : 3333333
1 Cm = 33 km.
Km. 33 0 33 66 99 132 Km.

PLATE NO. 11

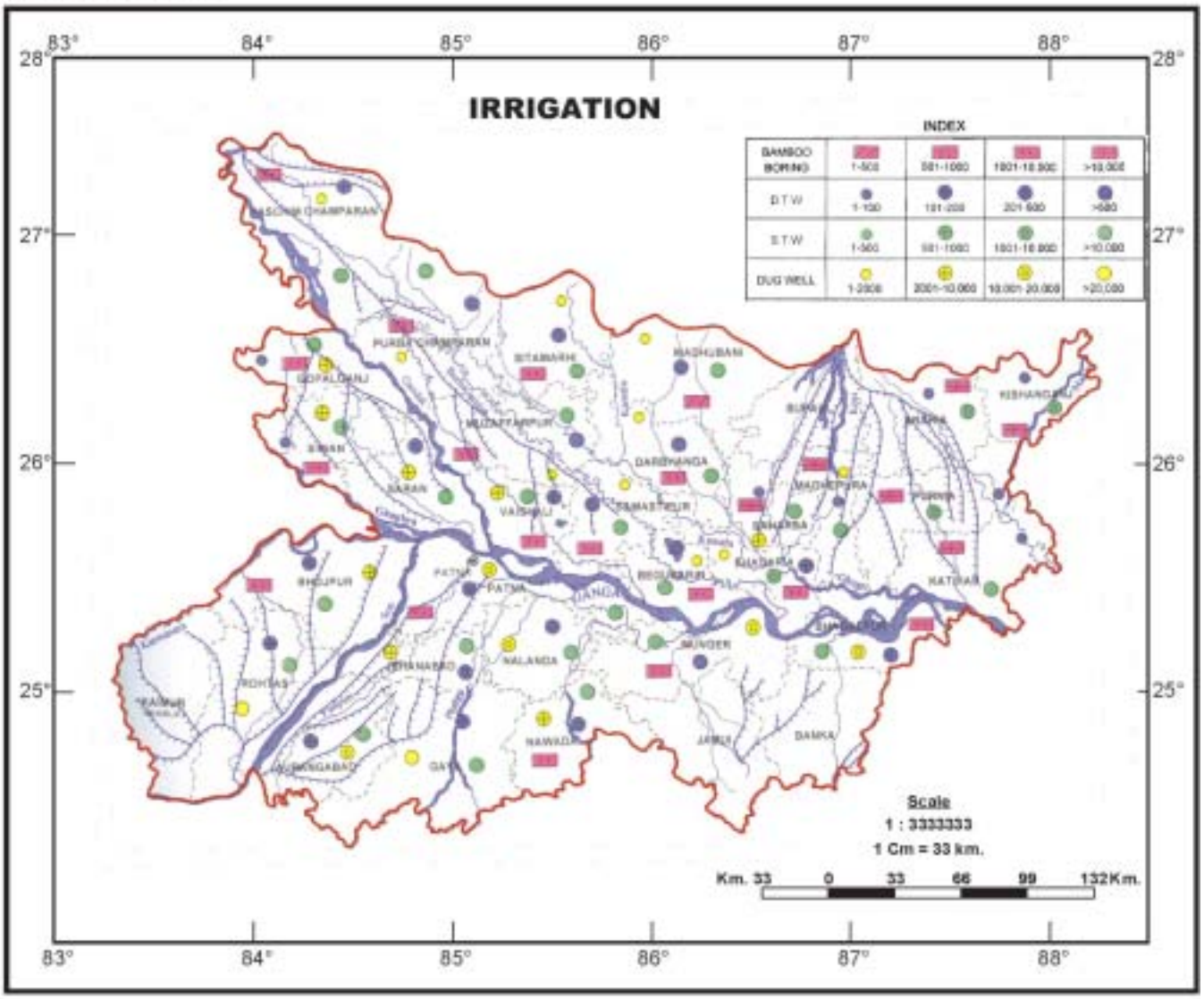
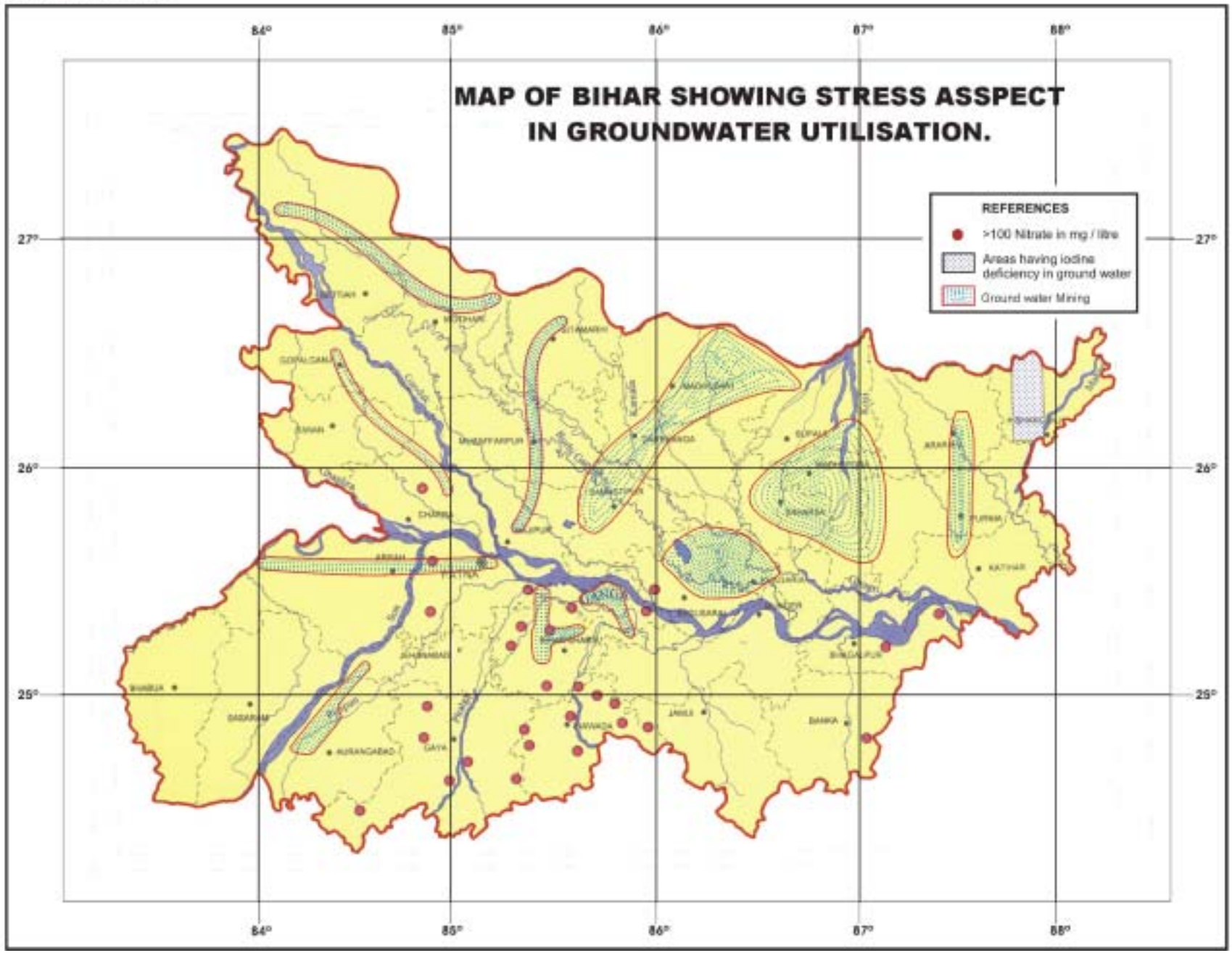
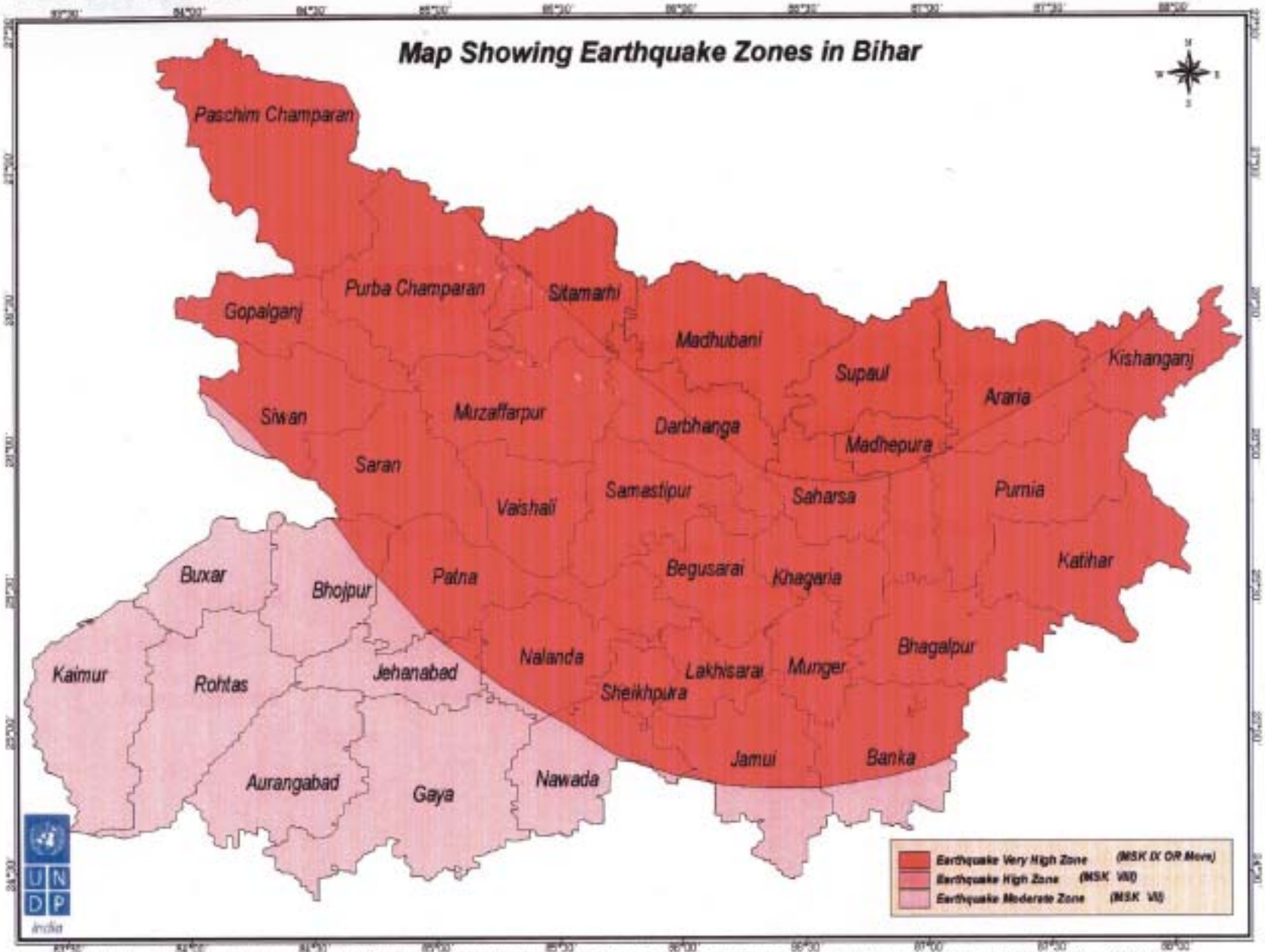

IRRIGATION
INDEX
BAMBOO BORING
D.T.W
S.T.W
DUG WELL
83°
84°
85°
86°
87°
88°
28°
27°
26°
25°
Scale
1 : 3333333
1 Cm = 33 km.
Km. 33 0 33 66 99 132Km.

PLATE NO. 12



Bihar State Pollution Control Board

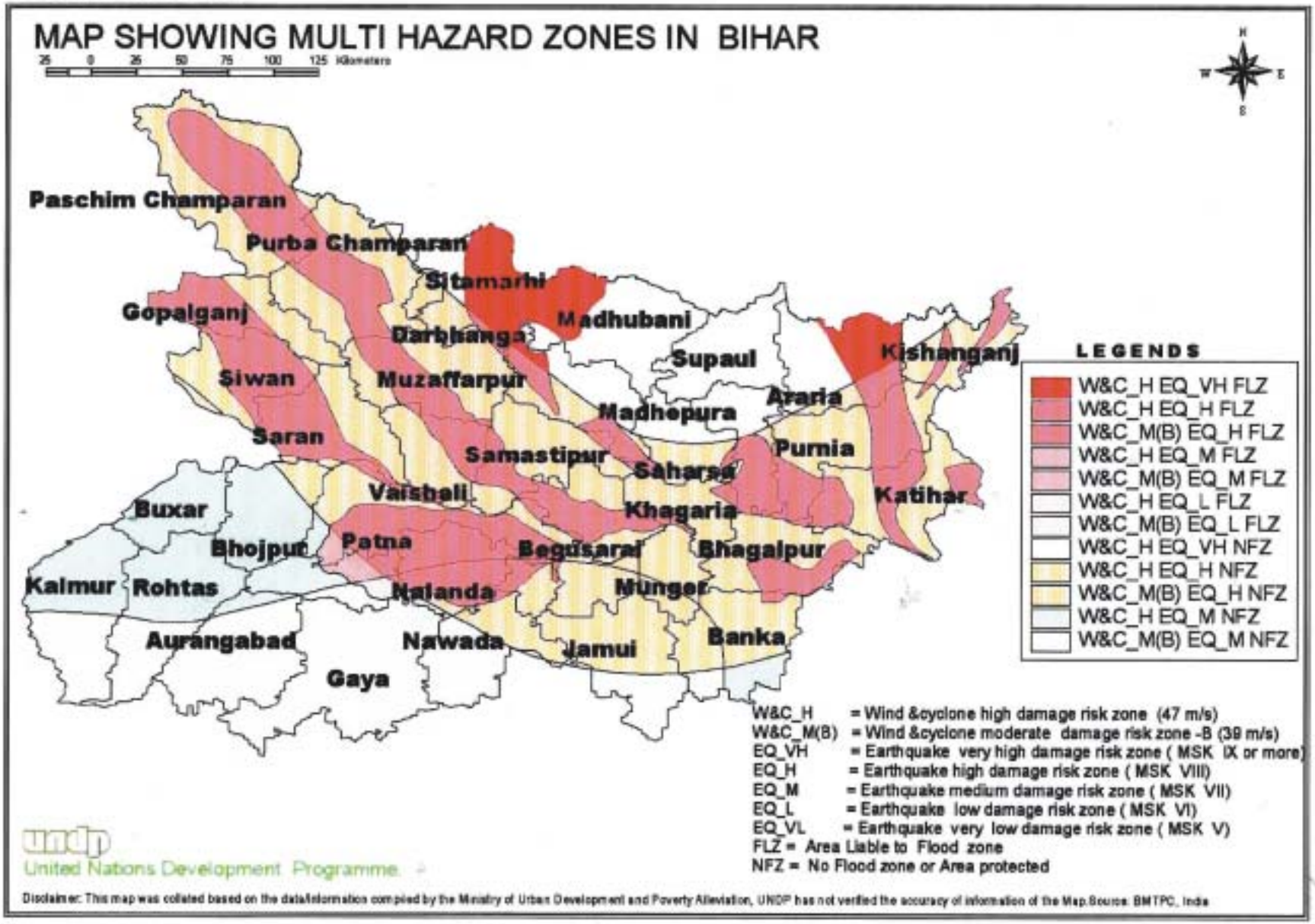
PLATE NO. 13



Disclaimer: This map was collated based on the data/information compiled by the Ministry of Urban Development and Poverty Alleviation; UNDP has not verified the accuracy of information of the Map.Source: BMTPC, India

PLATE NO. 14

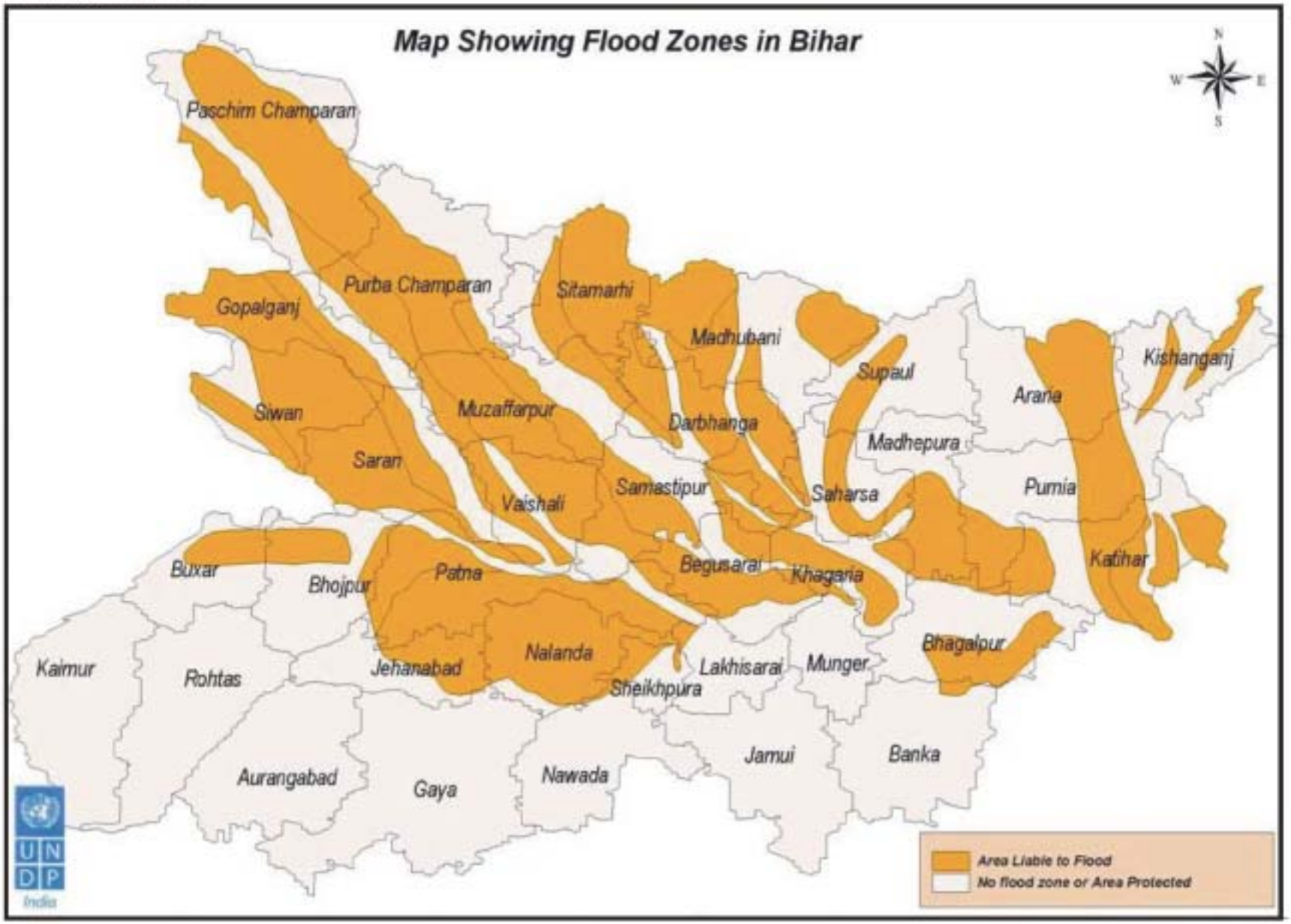
MAP SHOWING MULTI HAZARD ZONES IN BIHAR

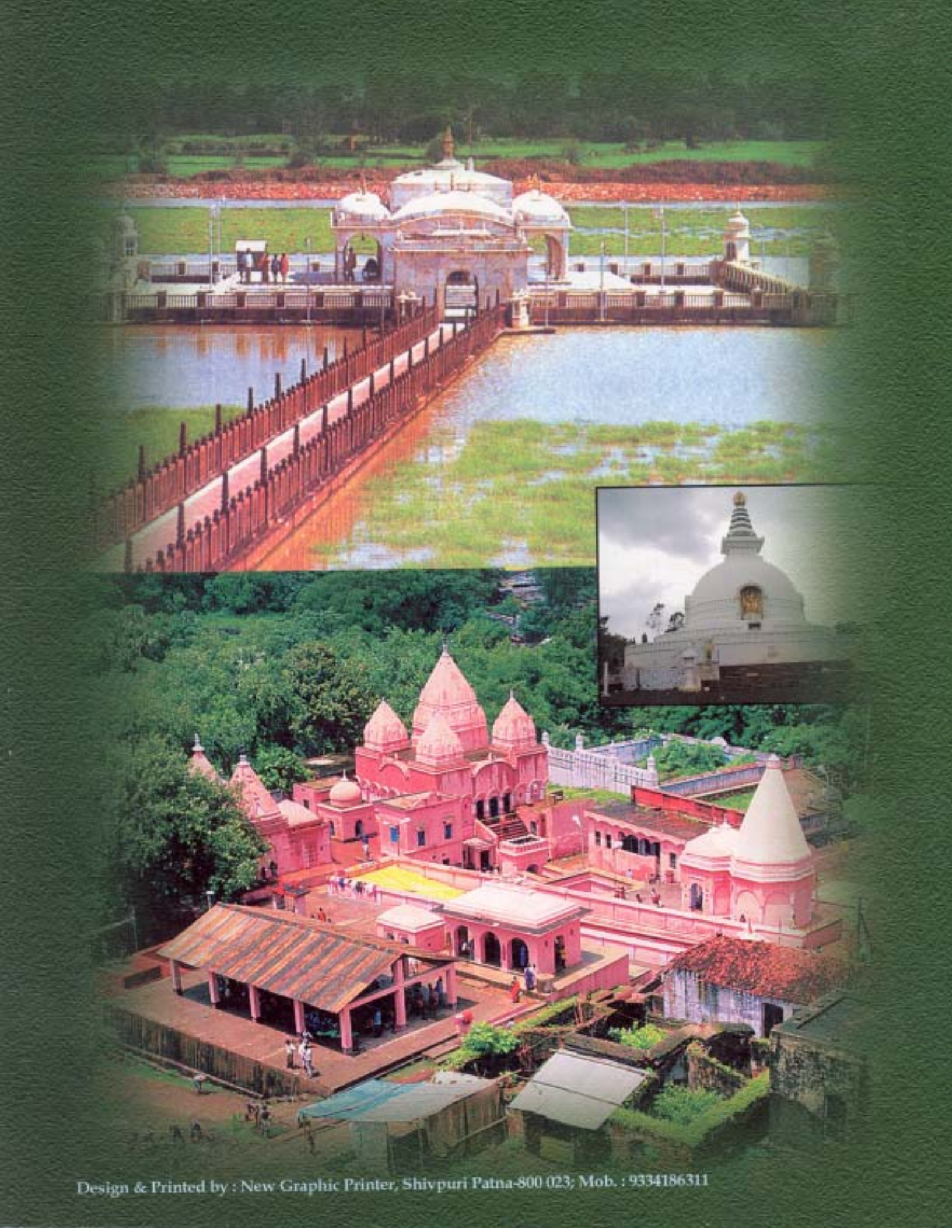


undp
United Nations Development Programme

Disclaimer: This map was collated based on the data/information compiled by the Ministry of Urban Development and Poverty Alleviation, UNDP has not verified the accuracy of information of the Map.Source: BMTPC, India

PLATE NO. 15





Design & Printed by : New Graphic Printer, Shivpuri Patna-800 023; Mob. : 9334186311