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HYDROLOGICAL INVENTORY OF SOUTH BIHAR RIVER BASINS

आपो हि ष्ठा मयोभुवः

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PREFACE

Hydrological modelling of a basin requires detailed hydrological information about the basin. Further, the hydrological information of a region or a basin is of immense use to water resources planners and managers. However, these hydrological information collected by different organisations are often scattered and are not in representable form. Keeping the above aspect in view, the Ganga Plains North Regional Centre has taken the task of compiling the hydrological information of the different river basins of South Bihar.

The state of Bihar, the ninth largest in size in the country, comprises alluvial plains of Indo-Gangetic basin in the north and Kaimur-Chotanagpur-Santhal Pargana plateau in the south. The alluvial plains is divided into two by the river Ganga flowing from west to east. South Bihar comprises the flat alluvial plains on the southern side of the river Ganga and the Kaimur-Chotanagpur-Santhal Pargana plateau.

In the present report, the hydrological information of seventeen different river basins of South Bihar have been compiled. The basinwise information regarding the location, areal extent, river system, land use pattern, soils, rainfall, surface and ground water resources, nature of hydrological problem and the location of gauge and discharge sites in each river basin have been presented.

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(S. M. Seth)
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LIST OF ABBREVIATIONS AND NOTATIONS

CMG	Discharge Data by Current Meter Gauging
CWC	Central Water Commission
Fig.	Figure
FM	Discharge Data by Float Method
GDSWQ	Gauge, Discharge, Silt and Water Quality
GS	Gauge Site
ha	hectare
km	kilometre
m	metre
MCM	Million Cubic Metre
sq. km.	Square kilometre
WRD	Water Resources Department, Govt. of Bihar

ABSTRACT

Hydrological information of a region provide the basic database for water resources planning and management. Without the knowledge of hydrological properties, neither a management approach nor a planning can achieve its goal. Hence, in this report an attempt is made to compile the hydrological information of all the river basins in South Bihar.

The state of Bihar, the ninth largest in size in the country is bounded by Himalayan foot hills and terrai region of Nepal on the north, West Bengal on the east, Orissa on the south and Madhya Pradesh and Uttar Pradesh on the west. The state comprises alluvial plains of Indo-Gangetic basin in the north and Kaimur-Chotanagpur-Santhal Pargana plateau in the south. The alluvial plains is divided into two by the river Ganga flowing from west to east. The Govt. of Bihar has physiographically divided the state into three regions, namely, North Bihar (comprising the tract of alluvial plains north of Ganga), Central Bihar (comprising the flat alluvial plains having the Ganga on the north and the area to the west of Rajmahal hills and north of the Kaimur-Chotanagpur-Santhal Pargana plateau) and South Bihar (comprising the Kaimur-Chotanagpur-Santhal Pargana plateau). However, in this report, the river basins of both Central and South Bihar has been treated as the river basins of South Bihar.

The hydrological information of seventeen different river basins of South Bihar have been compiled. The basinwise information regarding the location, areal extent, river system, land use pattern, soils, rainfall, surface and ground water resources, nature of hydrological problem and the location of gauge and discharge sites in each river basin have been presented.

1.0 INTRODUCTION

Hydrological information of a drainage basin or a region (consisting of a number of drainage basins) at large, provide the basic database for planning and management of water resources. Without the knowledge of hydrological properties of a drainage basin, neither a management approach nor a planning can achieve its goal. The first information one expects in planning and management is the space-time availability of quantity which can be ensured once the hydrological properties of the basin are known. On the other hand, solution of any hydrological problem needs the state of art of the basin characteristics. Keeping the above aspects in view, a compilation work of hydrological properties of South Bihar river basins is chosen.

The state of Bihar, the ninth largest in size in the country lies between latitudes $21^{0}58'10"N$ and $27^{0}31'15"N$ and longitudes $83^{0}10'50"N$ and $80^{0}17'40"N$. The total geographical area of the state is 1,73,877 sq. km. The state comprises alluvial plains of Indo-Gangetic basin in the north and Kaimur-Chotanagpur-Santhal Pargana plateau in the south. The alluvial plains is divided into two by the river Ganga flowing from west to east. The state, therefore, can physiographically be divided into three regions, namely, North Bihar, Ganga Stem and South Bihar.

The different river basins/sub-basins in South Bihar with the names of the rivers into which the main rivers outfall are shown in Table 1.1.

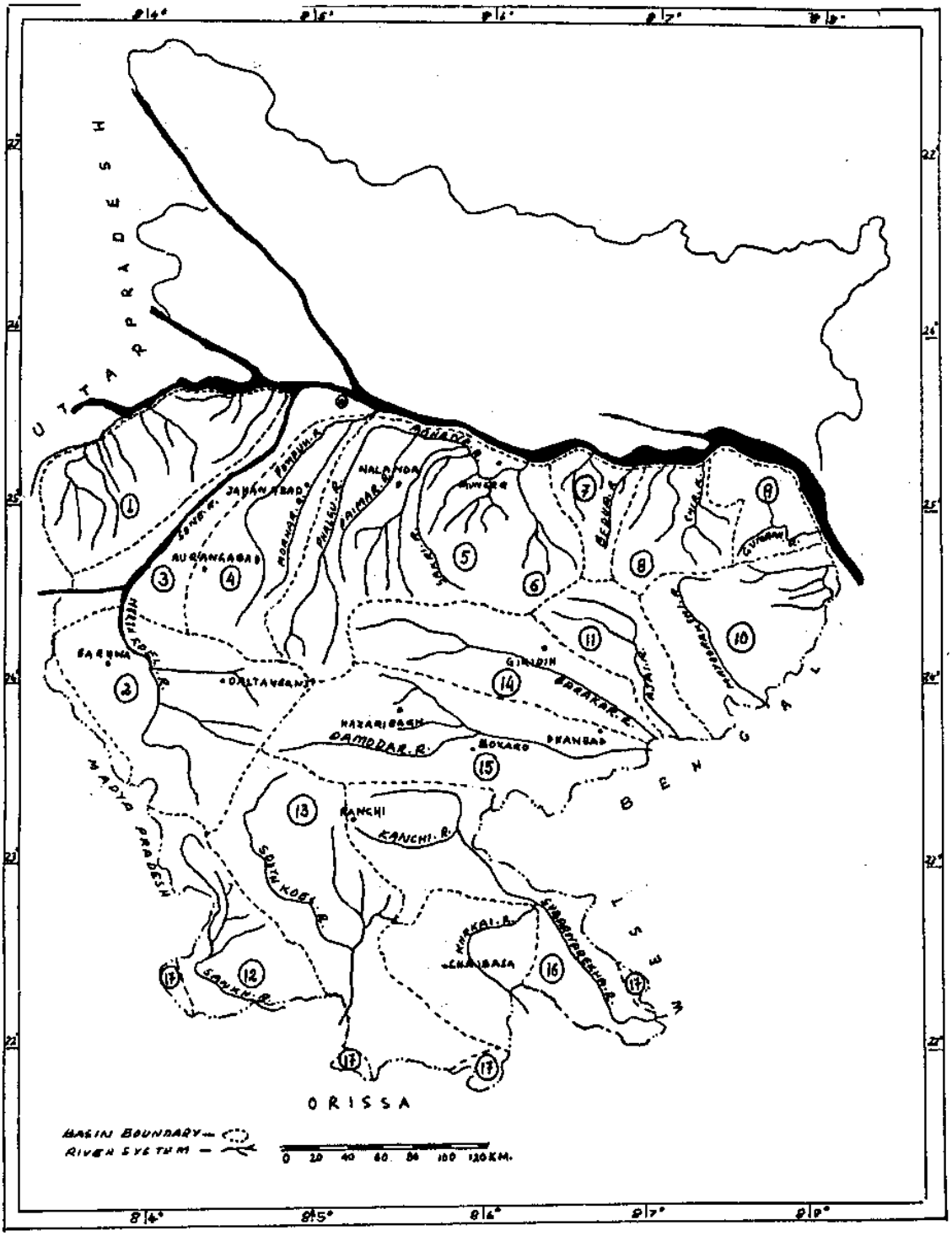
Table 1.1 Different River Basins of South Bihar

Sl. No.	Name of the Basin	Outfall of the Main River
1.	Karmnasa	Ganga
2.	North Koel	Sone
3.	Sone-Kanhar and Kao Gangi	Ganga
4.	Punpun	Ganga
5.	Harohar	Kiul

Sl. No.	Name of the Basin	Outfall of the Main River
6	Kiul	Ganga
7.	Badua-Belharna	Ganga
8.	Bilasi-Chandan-Chir	Ganga
9.	Gumani and Koa-Bhena	Ganga
10.	Mayurakshi and other adjoining streams	Bhagirathi
11.	Ajay	Bhagirathi
12.	Sankh	South Koel
13.	South Koel	Brahmani
14.	Barakar	Damodar
15.	Damodar	Bhagirathi
16.	Subarnarekha-Kharkai	Bay of Bengal
17.	Small streams draining independently outside the state	Brahmani

Fig. 1.1 shows the map of different river basins of South Bihar. The sections in the following chapter describe in detail the hydrological information of different river basins in South Bihar.

Fig. 1.1 Map Showing Different River Basins of South Bihar



1 Karmnasa Basin
2 North Koel Basin
3 Sone-Kanhar and Kao-Gangi Composite Basin
4 Punpun Basin
5 Harohar Basin
6 Kiul Basin
7 Badua-Belhatna Basin
8 Bilasi-Chandan-Chir Basin
9 Gumani and Koa-Bhena Basin
10 Basins of Mayurakshi and Other Adjoining Streams
11 Ajay Basin
12 Sankh Basin
13 South Koel Basin
14 Barakar Basin
15 Damodar Basin
16 Subarnarekha-Kharkai Basin
17 Basins of Small Streams Flowing Independently Outside the State

2.0 HYDROLOGICAL INVENTORY OF DIFFERENT SOUTH BIHAR RIVER BASINS

2.1 Karmnasa River Basin

2.1.1 Salient features of the river basin

The salient features of the river basin are as follows:

- The Karmnasa river basin is situated between latitudes $24^0$32' N and $25^0$31' N and longitudes $83^0$0' E and $84^0$5'E.
- The total geographical area of the basin is 5126.88 sq. km. of which 4918.29 sq. km. falls in Rohtas district including Bhabhua and 208.59 sq. km. in Bhojpur district.
- The basin covers 68.30 percent of Rohtas district including Bhabhua and 5.10 percent of Bhojpur district.
- As per the 1991 Census Report, the population of the basin is 17.44 lakh, the intensity of the population being 340 persons per sq. Km.

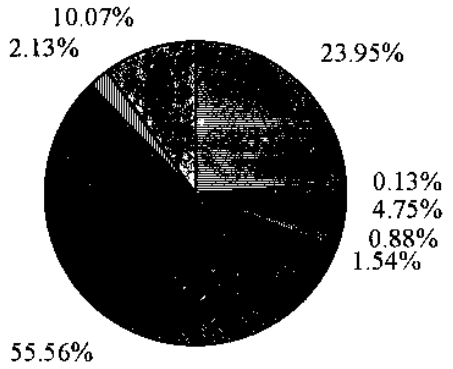
2.1.2 The river system

The river Karmnasa rises at an elevation of 560 m above MSL in the eastern ridges of the plateau in the Kaimur hills about 29 km west of Rohtasgar in Rohtas district of Bihar. The river flows in a north westerly direction in Bihar in a length of about 24 km and then forms the boundary between Bihar and Uttar Pradesh for a short distance from Gamharia Khurd to Sikerwar. It then flows through Mirzapur district of UP and again forms the boundary between Bihar and UP from the point where the river Gurwat joins it. Thereafter it again enters UP and flows through Varanasi district and later forms the boundary between Bihar and UP from village Siuri to its outfall in the river Ganga near Chausa. The river *Chandraprabha* and the river *Durgawati* are its important left and right bank tributary respectively. Total length of the river is 192 km, out of which 92 km lies in UP, 24 km in Bihar and the remaining 76 km forms the common boundary between Bihar and UP.

2.1.3. Land use pattern in the basin

Fig. 2.1 shows the land use pattern of the Karmnasa river basin.

FIG. 2.1 LAND USE PATTERN IN KARMNASA BASIN



2.1.4 Soils in the basin

This basin comprises the following categories of soils:

- Old alluvium-saline and alkali soils. This category of soil exists in north-western part of the basin.
- Old alluvium-reddish-yelow, yellowish-grey catenary soils. This category of soil exists in the central east and south-western part of the basin.
- Old alluvium-grey, greyish-yellow, heavy textured soils with cracking. This category of soil exists in the extreme eastern part of the basin in the shape of sectoral form.
- Old alluvium-yellowish red and yellow soils of foot hills. This category of soil exists in a strip of land extending from western boundary upto Dehri-on-sone.
- Hill forest soils of steep stopes and highly dissected region.

- Yellow reddish yellow medium deep and light textured catenary soils. A vast area of the basin in the south and enclosing Adhaura Plateau consists of this category of soil.

2.1.5 Surface and ground water potential

Surface water potential of the river basin is 1424.1 MCM which is equivalent to 18.3 cm of waterspread over the entire basin while the ground water potential is 1658.50 MCM.

2.1.6 Gauge and discharge sites in the basin

Table 2.1 lists the different gauge and discharge sites in the basin.

Table 2.1 List of Gauge and Discharge Sites in Karmnasa Basin

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
1	GT Road crossing	Karamnasa	WRD	FM
2	Kakaraighat	Karamnasa	WRD	FGSM
3	Jamania Pump	Ganga	WRD	FM
4	Kadaria dam site	Durgawati	WRD	FM
5	Panserwa	Durgawati	WRD	FM
6	Bhagwanpur	Suara	WRD	FM
7	Dam site	Durgawati	WRD	FM
8	Weir site	Durgawat	WRD	FM
9	Bahura	Kudra	WRD	FM
10	Pump site	Dharmawati	WRD	FM
11	Panjraw	Dharmawati	WRD	FM
12	G. T. road crossing	Kaoo	WRD	FM
13	Ara Mohania	Kaoo	WRD	FM
14	Malai Barrage crossing	Kaoo	WRD	FM
15	Karamnasa Rly. bridge.	Karamnasa	CWC	CMG

2.2 North Koel River Basin

2.2.1 Salient features of the river basin

The salient features of the river basin are as follows:

- The North Koel river basin is situated between latitudes 23^0 N and $24^0 30'$ N and longitudes $84^0 30'$ E and 85^0E.
- The total geographical area of the basin is 10570 sq. km. of which 8720 sq. km. falls in Palamu district, 900 sq. km. in Gumla district, 490 sq. km. in Lohardagga district and 460 sq. km. in Hazaribagh district.
- The basin covers 69.96 percent of Palamu district, 9.92 percent of Gumla district, 32.89 percent of Lohardagga district and 4.14 percent of Hazaribagh district.
- As per the 1991 Census Report, the population of the basin is 18.99 lakh, the intensity of the population being 180 persons per sq. km.

2.2.2 The river system

The river North Koel originates from Chotanagpur hills (Bardih forest) at an altitude of about 910 m. The *Amanat*, the *Auranga*, the *Banki* and the *Tahle* are its important tributaries. Its tributary, the Amanat has two main sub-tributaries, namely the *Jinjoy* and the *Maila*. The North Koel outfalls in the river Sone at Haider Nagar in Palamu district.

2.2.3 Land use pattern in the basin

Fig. 2.2 shows the land use pattern of the North Koel basin.

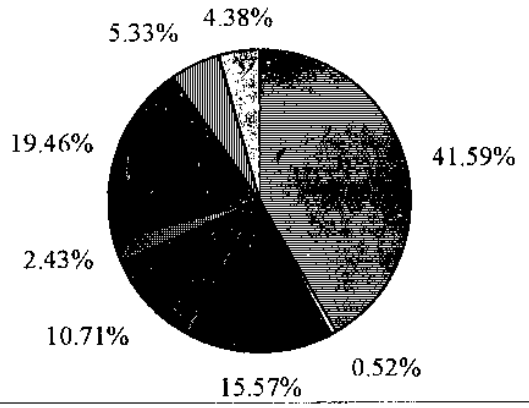
2.2.4 Soils in the basin

This basin comprises the following category of soils:

- Hill and forest soils of steep slopes and highly dissected regions. This category of soil exists in the north and south of the basin on basin on basin on both sides of the North Koel river and also in certain patches in central and south west portion.

- Upland grey, yellowish-grey, heavy soils on sedimentary and allied rocks. Such land exists in the central portion of the basin.
- Yellow, reddish-yellow, medium, deep and light textured catenary soils. This category of soil exisis in rest of the basin.

FIG. 2.2 LAND USE PATTERN IN NORTH KOEL BASIN



2.2.5 Surface and ground water potential

Surface water potential of the river basin is 2227.0 MCM which is equivalent to 21.1 cm of waterspread over the entire basin while the ground water potential is 680.0 MCM.

2.3 Sone-Kanhar and Kao-Gangi River Basin

2.3.1 Salient features of the river basin

The salient features of the river basin are as follows:

- The basin comprises three sub-basins namely: (a) Sone Stem, (b) Area draining in river Kanhar, and (c) Kao-Gangi (Ganga Stem).
- The total geographical area of the basin is 9374.71 sq. km. of which 289.83 sq. km. falls in Patna district, 2283.01 sq. km. in Rohtas district, 213.89 sq. km. in Jehanabad district, 3708.93 sq. km. in Bhojpur district, 581.14 sq. km. in Aurangabad district and 2297.91 sq. km. in Palamu district.
- As per the 1991 Census Report, the population of the basin is 50.25 lakh, the intensity of the population being 536 persons per sq. Km.

2.3.2 The river system

The river Sone is a major tributary (next only to Yamuna) of the river Ganga and meets the later on its right bank near Patna. Sone rises together with the Narmada and the Mahanadi on the elevated plateau of Central India. The river Sone has two main tributaries lying in Bihar portion, i.e. the *North Koel* and the *Kanhar*. The North Koel river originates in Bihar and outfalls also in Bihar whereas the river Kanhar has catchments in Bihar, MP and UP and it outfalls to the Sone in UP. A portion of catchment of Kanhar lies in Bihar.

2.3.3 Land use pattern in the basin

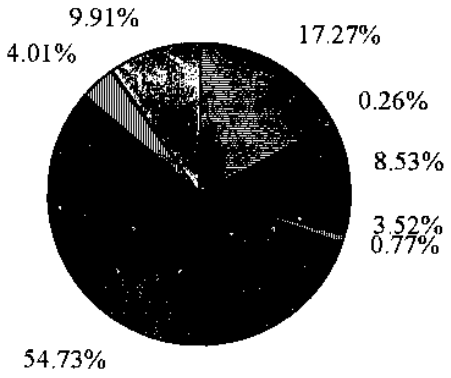
Fig. 2.3 shows the land use pattern of the Sone-Kanhar and Kao-Gangi basin.

2.3.4 Soils in the basin

This basin comprises the following categories of soils:

- Recent alluvium-calcareous. This category of soil exists in the northern part of the basin along the Ganges river from Buxar to Koilwar in Bhojpur district.

FIG. 2.3 LAND USE PATTERN IN SONE-KANHAR AND KAO-GANGI COMPOSITE BASIN



- Recent alluvium-yellowish to reddish yellow, non-calcerous, non-saline. Two narrow strips of land starting from Rohtas to Koilwar on both banks of river Sone fall in this category of soil.
- Tal land soils-light grey, dark grey. This category of soil in a long strip parallel to recent alluvium calcareous zone is located on both sides of the main railwaay line from Dumraon to Koilwar.
- Old alluvium-grey, greyish-yellow, heavy textured with cracking. In the heart of the Bhojpur district and Dawath block of Rohtas a bell shaped soil patch come under this category.
- Old alluvium-reddish, yellow, yellow-grey catenary soils. Eastern portion, central and north central portion of this basin around Husainabad and Hariharganj of Palamu district come under this category.

- Old alluvium-saline and saline-alkali soils. The western side of Bhojpur district and part of Rohtas district from Dinara to Buxar is a zone having this category of soil. It is found also in small patch at extreme southern tip of the basin.
- Hill and forest soils of steep slopes and highly dissected regions. A patch of land on the south-east southern part of the basin around Bhawnathpur in Palamu come under this category.
- Yellow, reddish-yellow, medium, deep and light textured catenary soils. The small strip of land in Palamu which is on the southern tip of the basin come under this category of soil.

2.3.5 Rainfall

The average annual rainfall varies from 134 cm in hilly terrain to 99 cm in the plains. About 85 percent of the total annual rainfall is received during monsoon period. The maximum value of 24 hours rainfall with 50 years frequency is in the range of 20 to 24 cm.

2.3.6 Surface and ground water potential

Surface water potential of the river basin is 8552 MCM while the ground water potential is 2507.4 MCM.

2.3.7 Gauge and discharge sites in the basin

Table 2.2 lists the different gauge and discharge sites in the Sone and North Koel basin.

Table 2.2 List of Gauge and Discharge Sites in Sone and North Koel Basin

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
1	Japala	Sone	CWC	CMG
2	Indrapuri	Sone	CWC	GS
3	Nasriganj	Sone	CWC	CMG
4	Koilwar	Sone	CWC	CMG

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
5	Daltanganj	N.Koil	CWC	CMG
6	Mohamadganj	N.Koil	CWC	CMG
7	Tardih	Ausane	WRD	FM

2.3.8 Nature of hydrological problems

Problems of flood particularly in the plains are a common phenomena. These are mainly caused due to inadequate passage of flow exit and topographical variation.

2.4 Punpun River Basin

2.4.1 Salient features of the river basin

The salient features of the river basin are as follows:

- The Punpun river basin is situated between latitudes $24^0 6'$ N and $25^0 35'$ N and longitudes $84^0 0'$ E and $85^0 19'$ E.
- The total geographical area of the basin is 9025.75 sq. km. of which 1046.25 sq. km. falls in Patna district, 1180.31 sq. km. in Jehanabad district, 2598.17 sq. km. in Gaya district, 2721.76 ha in Aurangabad district, 780.41 sq. km. in Palamu district, 20.90 sq. km. in Nalanda district and 677.95 sq. km. in Hazaribagh district.
- The basin covers 32.51 percent of the area of Patna district, 75.20 percent of Jehanabad district, 52.60 percent of Gaya district, 82.41 percent of Aurangabad district, 6.26 percent of Palamu district, 0.88 percent of Nalanda district and 6.11 percent of Hazaribagh district.
- As per the 1991 Census Report, the population of the basin is 49.94 lakh, the intensity of the population being 553 persons per sq. Km.

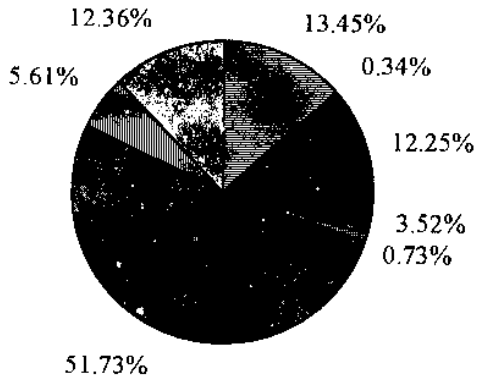
2.4.2 The river system

The river Punpun originates from Hariharganj block of Palamu district in the Chotanagpur plateau at an elevation of 442 m. In the head reach it receives the tributaries like *Batane*, *Adri*, *Madar* and *Kalan* and in the lower reach the river has got two main tributaries known as as *Morhar* and *Dardha* both running almost parallel to each other and meeting the main stream on the right bank east of Patna-Gaya road. After traversing about 15 km in north-east direction the river Punpun falls in the river Ganga near Fatuha which is about 20 km east of Patna.

2.4.3 Land use pattern in the basin

Fig. 2.4 shows the land use pattern of Punpun basin.

FIG. 2.4 LAND USE PATTERN IN PUNPUN BASIN



2.4.4 Soils in the basin

This basin comprises the following categories of soils:

- Old alluvium grey, greyish-yellow, heavy textured cracking soil. This category of soil exist in the form of an egg to longitudinally halved and located on north-east corner of the basin.
- Old alluvium reddish-yellow, yellow-grey catenary soils. A major part of the basin, lying in north, west and central south of the basin, belongs to this category.
- Old-alluvium saline, and saline-alkali soils. A small strip of land extending from east to west and located in south-central part of the basin belongs to this category.
- Hill and forest soil of steep slopes and highly dissected regions. This category of soil is in small oval shaped patches in the south central part of the basin.
- Yellow-reddish and yellow medium deep, light textured catenary soils. In the south eastern corner of the basin this category of soil exists.

2.4.5 Rainfall

Average annual rainfall varies from 99 cm near confluence with the Ganga (Patna district) to 134 cm in the upper most reach (Palamu district). About 85 to 87 percent of the annual rainfall occurs during monsoon period from June to September. The maximum value of 24 hours rainfall with 50 years frequency is 32 cm which occurs in the upper catchment while for other portions it is between 24 to 28 cm.

2.4.6 Surface and ground water potential

Surface water potential of the river basin is 2254 MCM which is equivalent to 24.97 cm of waterspread over the entire basin while the ground water potential is 2020 MCM.

2.4.7 Gauge and discharge sites in the basin

Table 2.3 lists the different gauge and discharge sites in Punpun basin.

Table 2.3 List of Gauge and Discharge Sites in Punpun Basin

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
1	Siris	Punpun	WRD	FM
2	Fatuha	Punpun	WRD	GS
3	Hamidnagar	Punpun	WRD	FM
4	Santhua	Barane	WRD	FM
5	Bharkol	Tekari	WRD	FM
6	Kendai	Morhar	WRD	FM
7	Nima	Morhar	WRD	FM
8	Raharia	Morhar	WRD	FM
9	Roshanganj	Morhar	WRD	FM
10	Panchanandpur	Morhar	WRD	FM
11	Ramjani	Jamune	WRD	FM

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
12	Bhuyiadih	Jam	WRD	FM
13	Patna-Mashaudi Rd.	Dardha	WRD	FM
14	Bari Bigha	Dardha	WRD	FM
15	Bendauli	Dhoba	WRD	FM
16	Fatuha drainage crossing	Dhoba	WRD	FM
17	Fatuha	Ganga	WRD	GS
18	Palmerganj	Punpun	CWC	GS
19	Kinjar	Punpun	CWC	GS
20	Sripalpur	Punpun	CWC	CMG
21	Mianchak	Morhar	CWC	CMG
22	Kolachak	Dardha	CWC	CMG
23	Kadiganj	Sakri	CWC	CMG

2.4.8 Nature of hydrological problem

Problem of surface drainage congestion due to inadequate passage of monsoon flow is a common phenomena.

2.5 Harohar River Basin

2.5.1 Salient features of the river basin

The salient features of the river basin are as follows:

- The Harohar river basin is situated between latitudes $24^0$10' N and $25^0$30' N and longitudes $84^0$40' E and $86^0$8' E.
- The total geographical area of the basin is 14296.18 sq. km. covering partially the districts of Patna, Nawada, Jehanabad, Gaya, Hazaribagh, Giridih, Munger and Nalanda.
- The basin covers 26.11 percent of Patna district, 99.16 percent of Nawada district, 11.16 percent of Jehanabad district, 47.40 percent of Gaya district, 31.16 percent of Hazaribagh district, 12.13 percent of Giridih district, 28.53 percent of Munger district and 99.12 percent of Nalanda district.
- As per the 1991 Census Report, the population of the basin is 71.324 lakh, the intensity of the population being 499 persons per sq. Km.

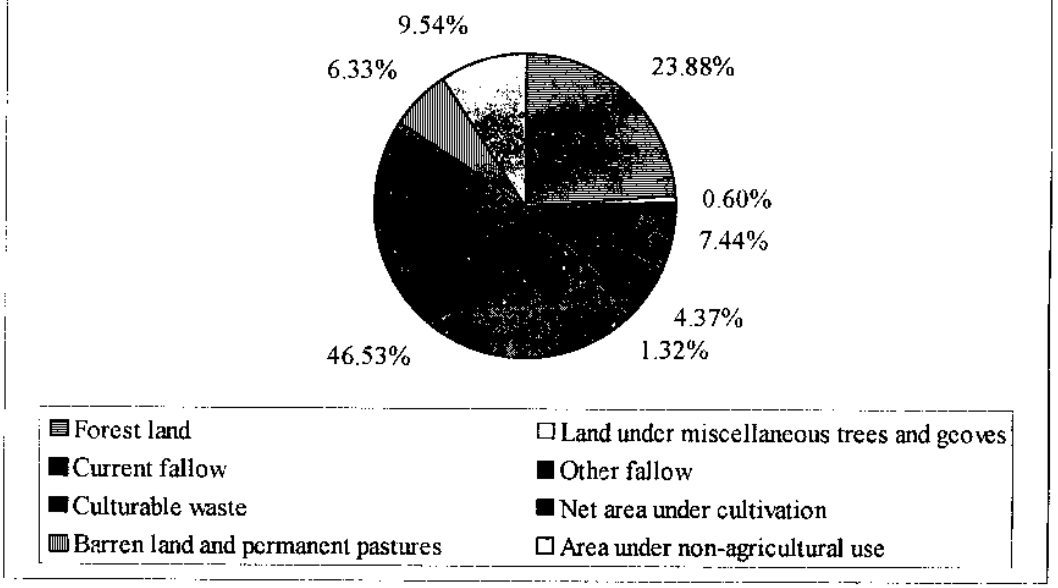
2.5.2 The river system

The river Harohar is the principal tributary of the river Kiul having its sub-tributaries like the *Dhadhar*, the *Sakri*, the *Kaurihari*, the *Panchane* and the *Phalgu*. The river Phalgu is the united stream of the river *Mohane* and the *Lilajan*, both having their origins in the hills of Hazaribagh district. The river *Paimar* rises near village Sichugora in Nawada district and is joined by a branch of river Phalgu and falls into the *Dhoa*, which is in fact the river Phalgu in its lower reach. Dhoa later gets converted into the Harohar. The river Sakri originates in the hills of Giridih district near village Tisri and after flowing through bordering area of Hazaribagh, it enters the district of Nawada near Gobindpur and lower below the river splits up into several channels which join the river Harohar.

2.5.3 Land use pattern in the basin

Fig. 2.5 shows the land use pattern of Harohar basin.

FIG. 2.5 LAND USE PATTERN IN HAROHAR BASIN



2.5.4 Soils of the basin

This basin comprises the following categories of soils:

- Recent alluvium-calcareous. This category of soil exists in a very narrow strip from west to east along the right bank of the river Ganga.
- Tal land soils, light grey-dark grey medium to heavy textured soils. This category of soil exists between Fatuha in the west upto Surajgarha in the east in a strip of land.
- Old alluvium redish-yellow, yellow, grey catenary soils. A sizeable part of the basin in the middle consists of this category of soil. It extends from Manpur in Gaya district upto Harnaut in north and Lakhisarai in north-east corner. It is also found in southern part of the basin.

- Old alluvium grey greyish-yellow heavy textured soils with cracking. This category of soil exists in a half egg shaped patch in the western part of the basin as well as in a small rectangular patch around Ariari block of Jamui district.
- Hill and forest soils of steep slopes and highly dissected region. This category of soil exists in south-central part of the basin extending from Sirdala in Nawada district to Gawan block of Giridih district in the east.
- Old alluvium, yellowish red-yellow soils of foot hills. A small patch of soil rectangular in shape in Gaya district and extending towards east upto Sikandra in Jamui district comes under this category of soil.
- Pale-yellow, yellow, pinkish deep catenary soils on micaceous schists. This category of soils exists in extreme southern part of the basin and covers part of Koderma, Markacho and Tisri blocks.

2.5.5 Rainfall (Kiul-Harohar river basin)

The average annual rainfall varies from 99 cm in the lower catchment of the river to 126 cm in the hills of Hazaribagh district. About 85 percent of the annual rainfall occurs during the monsoon months from June to September.

2.5.6 Surface and ground water potential

Surface water potential of the river basin is 3328.3 MCM which is equivalent to 23.28 cm of waterspread over the entire basin while the ground water potential is 2660 MCM.

2.5.7 Gauge and discharge sites in the basin

Table 2.4 lists the different gauge and discharge sites in the Kiul-Harohar basin.

Table 2.4 List of Gauge and Discharge Sites in Kiul-Harohar Basin

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
1	Kaithan	Lilijan	WRD	FM

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
2	Bhuiadih	Lilijan	WRD	FM
3	Weir site	Lilijan	WRD	FM
4	Udrasthan	Falgu	WRD	FM
5	Manui	Falgu	WRD	FM
6	Jeevanchak	Bhaitamain	WRD	FM
7	Armedag	Mohane	WRD	FM
8	Bhaluchatti	Mohane	WRD	FM
9	Bardih	Mohane	WRD	FM
10	Islampur	Mohane	WRD	FM
11	Ekangalsarai	Daha	WRD	FM
12	Weir Site	Paimar	WRD	FM
13	Aamghat	Tilaiya	WRD	FM
14	Jalalpur	Tilaiya	WRD	FM
15	Siur	Dhanarji	WRD	FM
16	Padmaul(Wier)	Dhanarji	WRD	FM
17	Rahimpur(Weir)	Rabri	WRD	FM
18	Nawada	Rabri	WRD	FM
19	Giriyak	Panchane	WRD	FM
20	Baribali	Tilaiya	WRD	FM
21	Weir site	Goithawa	WRD	FM
22	Rahimpur	Khuri	WRD	FM
23	Gath	Chiraiya	WRD	GS
24	Chandi	Mohane	WRD	FM
25	Bihar-Barbigha rd.	Paimar	WRD	FM
26	Bihar-Barbigha rd.	Panchane	WRD	FM

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
27	Dhamauli	Panchane	WRD	GS
28	Panchane Weir1&2	Khunti	WRD	FM
29	Khunta	Sakari	WRD	FM
30	Baskoi	Sakari	WRD	FM
31	Goharnagar	Bhauara	WRD	FM
32	Bihar-Barbigha	Jirain	WRD	FM
33	Aamgachi	Sakari	WRD	GS
34	Bihar-Barbigha	Kumhari	WRD	GS
35	Nata weir	Nata	WRD	FM
36	Weir site	Kanahari	WRD	FM
37	Sheikpura Sarbigha	Tati	WRD	FM
38	Dam site(Kashoia)	Banbani	WRD	FM
39	Dam site	Kundghat	WRD	FM
40	Sheikpura-Lakhisarari	Kanhari	WRD	FM
41	Sheikpura Kuil	Saru	WRD	FM
42	Dam site	Ulai	WRD	GS
43	Kari-Hari Harihar complex	Harihar	WRD	FM
44	Lakhisarai- Munger	Kuil	WRD	FM
45	Barahia-Lakhisarai	Harohar	WRD	GS
46	Fatuha -Daniyawa	Dhoba(Tal)	WRD	GS
47	Khusrupur	Ganga	WRD	GS
48	Bidhipur	Ganga	WRD	GS
49	Bhaktiarpur	Ganga	WRD	GS
50	Piparia	Ganga	WRD	GS

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
51	Barh	Ganga	WRD	GS
52	Siunar	Ganga	WRD	GS
53	Mahendrapur	Ganga	WRD	GS
54	Hemaja	Ganga(Tal)	WRD	GS
55	Hemaja	Ganga	WRD	GS
56	Railway crossing	Harohar	WRD	GS
57	Sarma	Kuil	WRD	GS
58	Piparia	Ganga	WRD	GS
59	Kuil-Harohar Bridge	Kuil	WRD	GS
60	Suryagarha	Harohar	WRD	GS
61	Hevarghat	Harohar	WRD	GS
62	Sudarpur	Ganga-Harohar	WRD	GS
63	Munger	Ganga	WRD	GS
64	Lehra	Dhadhar	WRD	FM
65	Ratukha	Mohane	WRD	FM
66	Hafua	Lilajan	CWC	FM
67	Lakhisarai	Kuil	CWC	CMG
68	Mankatha	Harehar	CWC	CMG
69	Gaya	Faigu	WRD	CMG

2.5.8 Nature of hydrological problem (Kiul-Harohar river basin)

Water logging and drainage problem occurs in the monsoon period upto November limited to Mokama Tal having an area of 1300 sq. km. Inadequate passage for exit of monsoon water causes water logging in the Tal areas. Flooding is also caused by the entry

of backwater of Ganga through Harohar. Occurences of flash floods particularly in rivers Sakri and Phalgu are often observed.

2.6 Kiul River Basin

2.6.1 Salient features of the river basin

The salient features of the river basin are as follows:

- The Kiul river basin is situated between latitudes $24^0$27' N and $25^0$16' N and longitudes $85^0$58' E and $86^0$30' E.
- The total geographical area of the basin is 2927.32 sq. km. covering partially the districts of Nawada, Giridih and Munger.
- The basin covers 0.84 percent of Nawada district, 6.18 percent of Giridih district and 39.10 percent of Munger district.
- As per the 1991 Census Report, the population of the basin is 10.161 lakh, the intensity of the population being 347 persons per sq. km.

2.6.2 The river system

The river Kiul has its origin in the village Chauki (Khargdiha) of the district Giridih and flowing for about 28 km along the border of the district, it enters into the district of Munger. On the way the sub-tributaries like *Barnar*, meets the river on the right bank and the main tributaries like *Harohar* on the left bank before its outfall into the river Ganga near village Surajgarha in Munger district.

2.6.3 Land use pattern in the basin

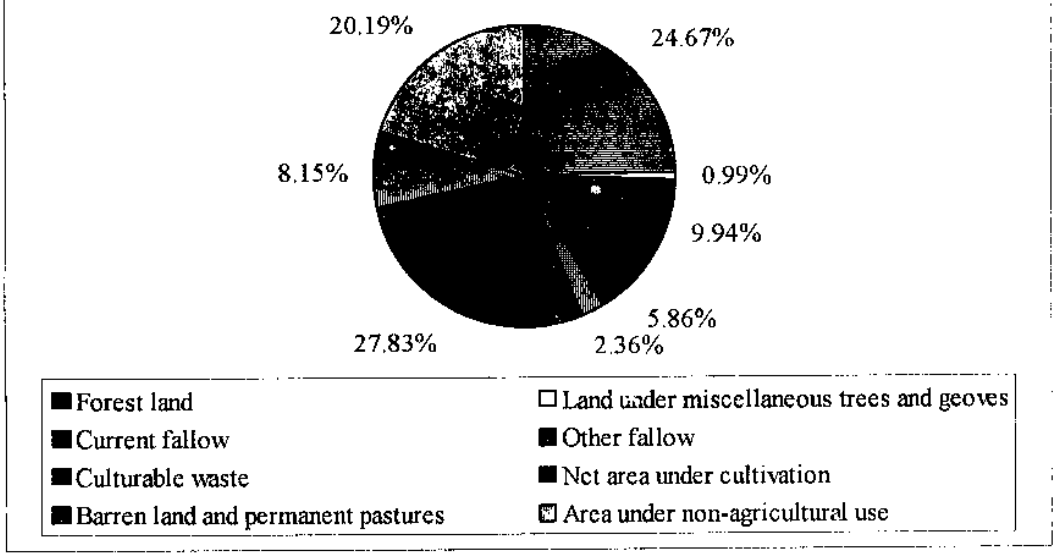
Fig. 2.6 shows the land use pattern of Kiul basin.

2.6.4 Soils in the basin:

This basin comprises the following categories of soils:

- Recent alluvium-calcareous. This category of soil exists on the extreme north eastern tip of the basin on the right bank of the river Ganga, but west of the Kiul river.

FIG. 2.6 LAND USE PATTERN IN KIUL BASIN



- Tal land soils, light-grey dark-grey, medium to heavy textured soil. This category of soil exists in a small triangular patch in the south of the recent alluvium calcareous soil zone with tapering towards east.
- Old alluvium yellowish red, yellow soils of foot hills. This category of soil exists in entire basin from north to south on the eastern side.
- Hill and forest soils of steep slopes and hilly dissected region. This category of soil exists in a triangular form patch in the middle and eastern part of the basin with its broad side in the east and tapering towards the west.
- Old alluvium reddish-yellow, yellow, grey catenary soil. This category of soil exists in a small patch at the north western tip of the basin.

2.6.5 Surface and ground water potential

Surface water potential of the river basin is 682 MCM which is equivalent to 23.28 cm of waterspread over the entire basin while the ground water potential is 426.0 MCM.

2.7 Badua-Belharna River Basin

2.7.1 Salient features of the river basin

The salient features of the river basin are as follows:

- The Badua-Belharna river basin is situated between latitudes $24^0$35' N and $25^0$25' N and longitudes $86^0$22' E and $86^0$55' E.
- The total geographical area of the basin is 2215 sq. km. of which 981 sq. km. falls in Munger district and 1234 sq. km. in Bhagalpur district.
- The basin covers 15.33 percent of Munger district and 21.89 percent of Bhagalpur district.
- As per the 1991 Census Report, the population of the basin is 10.78 lakh, the intensity of the population being 487 persons per sq. km.

2.7.2 The river system

The river Badua originates from the hills of Chakai block in Munger district at an elevation of about 333 m. After flowing for a small distance in Munger district, it enters Bhagalpur district and flows through it for most part of its course. It falls into the Ganga near Nathnagar (West of Bhagalpur) through Chanan Nadi. The Belharna river runs almost parallel to the Badua river on its left and falls independently into the Ganga about 26 km above the outfall of the Badua.

2.7.3 Land use pattern in the basin

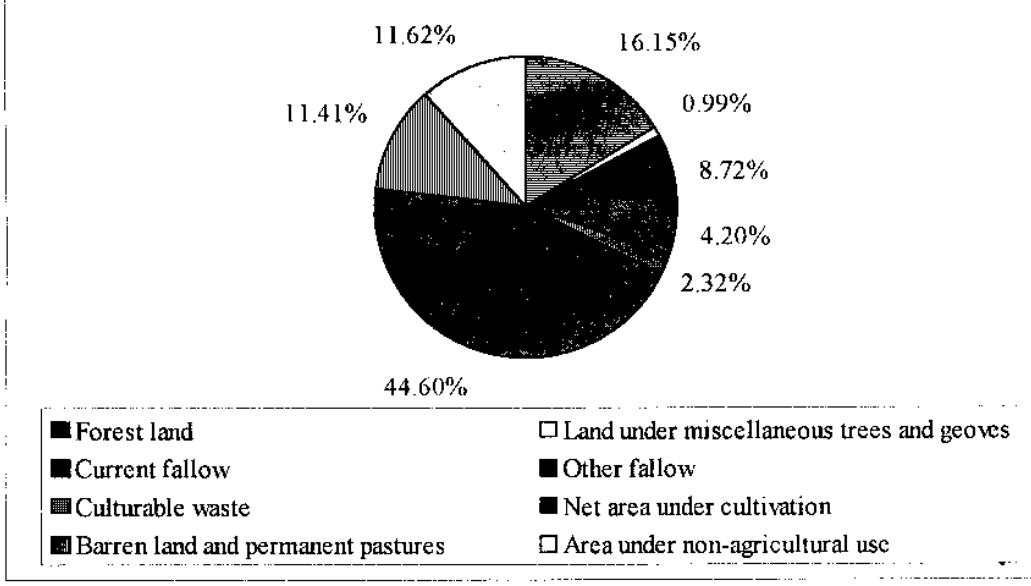
Fig. 2.7 shows the land use pattern of Badua-Belharna basin.

2.7.4 Soils of the basin

This basin comprises the following category of soils:

- Recent alluvium-calcareous. This category of soil exists in extreme north around the bank of the river Ganges.

FIG. 2.7 LAND USE PATTERN IN BADUA-BELHARNA BASIN



- Tal land soils-light grey-dark grey medium to heavy textured soils. This category of soil exists in south of the recent alluvium calcareous zone.
- Old alluvium, reddish-yellow, grey catenary soils. This category of soil exists in a rectangular shape on the eastern side of the basin.
- Old alluvim-grey, greyish yellow, heavy textured soils with cracking. This category of soil exists in a rectangular patch in the west of the basin and also near Shambhuganj and Sangrampur.
- Old alluvium-yellowish red, yellow soils of foot hills. This category of soil exists in south central part of the basin in a wide strip.
- Hill and forest soils of steep slopes and highly dissected regions. A trapezoidal shape of land around Kharagpur has this category of soil.
- Red-yellow-light grey catenary soil. This category of soil exists on extreme southern tip of the basin.

2.7.5 Rainfall

The average annual rainfall varies from 104 cm in the hills to 137 cm in the plains. About 80 percent of the annual rainfall occurs during the monsoon period from June to September.

2.7.6 Surface and ground water potential

Surface water potential of the river basin is 736.8 MCM which is equivalent to 33.3 cm of waterspread over the entire basin while the ground water potential is 590.5 MCM.

2.7.7 Nature of hydrological problem

Problem of flash flood in the plains for a duration of 7-8 hours due to heavy rain in the hilly catchment is usually observed.

2.8 Bilasi-Chandan-Chir River Basin

2.8.1 Salient features of the river basin

The salient features of the river basin are as follows:

- The Badua-Belharna river basin is situated between latitudes $24^0$30' N and $25^0$17' N and longitudes $84^0$36' E and $87^0$27' E.
- The total geographical area of the basin is 4090 sq. km. of which 2610 sq. km. falls in Bhagalpur district, 310 sq. km. in Deoghar district, 200 sq. km. in Dumka district and 970 sq. km. in Godda district.
- The basin covers 46.33 percent of Bhagalpur district, 12.38 percent of Deoghar district, 41.26 percent of Godda district and 3.62 percent of Dumka district.
- As per the 1991 Census Report, the population of the basin is 21.90 lakh, the intensity of the population being 535 persons per sq. km.

2.8.2 The river system

The river Chandan originates from hills of Deoghar at an elevation of 274 m and after traversing 110 km length bifurcates into number of small channels with deltaic river characteristics before meeting the river Ganga through Yamunia nala. The river Bilasi runs almost parallel to the Chandan river. The important tributaries of the Chandan are *Orni*, *Kudar* and *Chatri*, and that of Chir are *Sukhania*, *Kajhia*, *Harna*, *Sundar* and *Gahra* rivers.

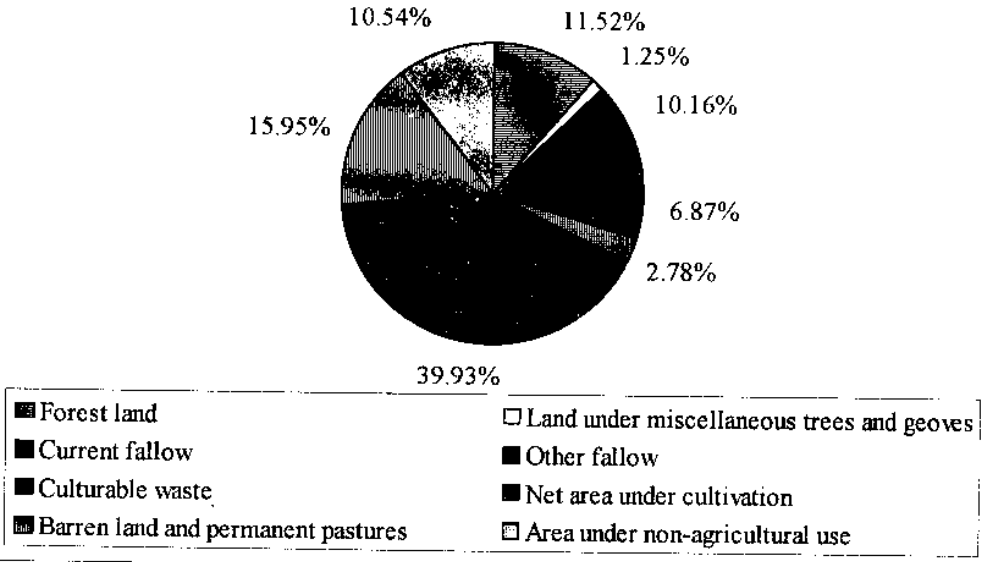
2.8.3 Land use pattern in the basin

Fig. 2.8 shows the land use pattern of Bilasi-Chandan-Chir basin.

2.8.4 Soils of the Basin

This basin comprises of the following category of soils:

FIG. 2.8 LAND USE PATTERN IN BILASI-CHANDAN-CHIR BASIN



- Tal land soils-light grey, dark grey. This category of soil exists in a narrow strip in the northern part of the basin but south of the recent alluvium calcareous zone .
- Old alluvium-reddish yellow, grey catenary soils. This category of soil exists in the basin in a wide strip extending from east to west and located in the south of the Tal land soils mentioned above.
- Old alluvium-grey, greyish yellow, heavy textured soils with cracking. This category of soil exists in the centre of the basin in a wide strip from east to west.
- Old alluvium yellowish-red, yellow soils of foot hills. This category of soil exists in the central zone of the basin around Banka and Godda.
- Hill and forest soils of steep slopes and highly dissected regions. This category of soil exists in 'Z' shaped narrow strip in the south eastern portion of the basin.
- Red-yellow-light grey catenary soil. This category of soil exists in the southern part of the basin.

2.8.5 Rainfall

The average annual rainfall varies from 128 cm in Santhal Paraganas district to 108 cm in the Bhagalpur district. About 75 to 80 percent of the annual rainfall occurs during monsoon months from June to September.

2.8.6 Surface and ground water potential

Surface water potential of the river basin is 1491 MCM which is equivalent to 36.4 cm of waterspread over the entire basin while the ground water potential is 893 MCM.

2.8.7 Gauge and discharge sites in the basin

Table 2.5 lists the different gauge and discharge sites in the Bilasi-Chandan-Chir basin.

Table 2.5 List of Gauge and Discharge Sites in Bilasi-Chandan-Chir Basin

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
1	Kudra	Kudra	WRD	FM
2	Dakara	Dakara	WRD	FM
3	Dhodha	Dhodha	WRD	FM
4	Phulwaria	Khalkhalia	WRD	FM
5	Chapanala	Champanala	WRD	GS
6	Barari	Ganga	WRD	GS
7	Kadua Lailakh	Kataria	WRD	GS
8	Shankarpur	Dhodha	WRD	GS
9	Mirjapurghat	Kodarkatti Nala	WRD	FM
10	Puraini	Chandan	WRD	FM
11	Bhukaria	Chandan	WRD	FM
12	Aamgachi	Sakri	WRD	FM
13	Kanka	Kajhia	WRD	FM

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
14	Saidpur	Chirkajhua	WRD	FM
15	Koabridge	Kasia	WRD	FM
16	Rly.bridge	Maina	WRD	FM
17	Pair	Gerua	WRD	FM
18	Sanhaula	Gahra	WRD	FM
19	Pair	Chir	WRD	FM
20	Sukhania	Sukhania	WRD	FM
21	Chir	Chir	WRD	FM
22	Karharia	Gerua	WRD	FM
23	Rly.bridge	Gerua	WRD	FM
24	Trimohani Road	Conf. Pt of Gerua	WRD	FM
25	Kahalgao (Shaikpura)	Ganga	WRD	GS
26	Pirpainti(Bakiaghat)	Ganga	WRD	GS
27	Mirchachak	Ganga	WRD	GS
28	Sankarpur	Ganga	WRD	GS
29	Lailakh	Ganga	WRD	GS

2.8.8 Nature of hydrological problem

Problem of flash flood of shorter duration in the lower stretches due to heavy rainfall in the upper stretches is observed during monsoon period. Blockage of flow due to the higher stage in the Ganga causes flooding.

2.9 Gumani and Koa-Bhena Composite River Basin

2.9.1 Salient features of the composite river basin

The salient features of the river basins are as follows:

- The Gumani river basin is situated between latitudes $24^0$40' N and $25^0$28' N and longitudes $87^0$31' E and $88^0$10' E while the Koa-Bhena river basin is situated between latitudes $25^0$0' N and $25^0$20' N and longitudes $86^0$58' E and $87^0$37' E.
- The total geographical area of Gumani basin is 2271.9 sq. km. of which 2000 sq. km. falls in Sahebganj district and 271.9 sq. km. in Godda district whereas the total geographical area of Koa-Bhena basin is 2014.18 sq. km. of which 1009.07 sq. km. falls in Godda district, 406.56 sq. km. in Sahebganj district, 510.74 sq. km. in Bhagalpur district and 87.81 sq. km. in Dumka district.
- The Gumani basin covers 48.15 percent of Sahebganj district and 11.48 percent of Godda district whereas the Koa-Bhena basin covers 42.66 percent of Godda district, 9.79 percent of Sahebganj district, 9.07 percent of Bhagalpur district and 1.58 percent of Dumka district.
- As per the 1991 Census Report, the population of the Gumani and Koa-Bhena basin is 13.82 lakh, the intensity of the population being 322 persons per sq. km.

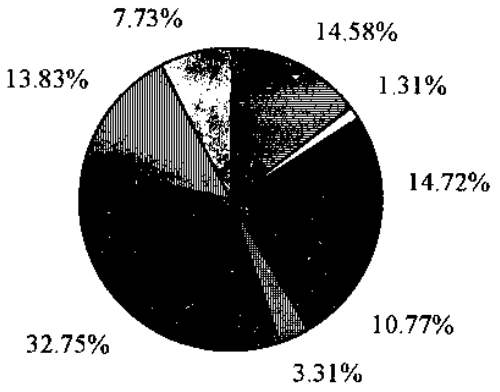
2.9.2 The river system

The river Gumani originates from open mixed forest of hills of Damau-Rajmahal range near Tetaria at an elevation of 338 m. After traversing 120.9 km in Bihar and 4.5 km along the Bihar West Bengal border it flows for 1 km in West Bengal before falling in the Ganga. Its main tributaries are *Darmonala*, *Morang* or *Maral* river. *Parwa* river meets in the upper reach of Morang river. The Koa river originates from the hills of Godda-Pakur as two main rivers namely, the *Dulia* and the *Lohra* which meet together to form the Koa river. The Koa finally falls in the river Ganga.

2.9.3 Land use pattern in the basin

Fig. 2.9 shows the land use pattern of Gumani and Koa-Bhena basin.

FIG. 2.9 LAND USE PATTERN IN GUMANI AND KOA-BHENA BASIN



2.9.4 Soils in the basin

This basin comprises the following categories of soils:

- Young alluvium-non calcareous-non saline. This category of soil exists in a small patch in northern part of the basin.
- Tal land soils-light grey, dark grey, medium to heavy textured soils. This soil exists in the extreme east of the basin on the right side of the Ganges river.
- Old alluvium-reddish yellow, yellowish-grey catenary soils. This category of soil is located in the basin in north, western part.
- Old alluvium yellowish-red, yellow soils and foot hils. This category of soil exists in the east of the basin in a wide strip from north to south and in a circular patch near Sahebganj.

- Hill and forest soils of steep slopes and highly dissected regions. This category of soil exists in the south-western and central part of the basin.
- Reddish yellow-yellow-greyish yellow, deep catenary soils of coal belt. This category of soil exists in the central south part of the basin.
- Yellow red-yellow black, catenary soils on Rajmahal trap rock. This category of soil exists in the northern central part of the basin in a broad patch.

2.9.5 Surface and ground water potential

Surface water potential of the Gumani river basin is 841 MCM which is equivalent to 37 cm of waterspread over the entire basin while the ground water potential is 138.14 MCM. Surface water potential of the Koa-Bhena river basin is 822 MCM which is equivalent to 40.6 cm of waterspread over the entire basin while the ground water potential is 224.83 MCM.

2.9.6 Gauge and discharge sites in the basin

Table 2.6 lists the different gauge and discharge sites in the Gumani basin.

Table 2.6 List of Gauge and Discharge Sites in Gumani Basin

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
1	Barhat	Dhomani	WRD	FM
2	Borio	Moral	WRD	FM
3	Jaijori	Gumani	WRD	FM
4	Chanar	Chanarjhil	WRD	GS
5	Radhanagar	Gumani	WRD	GS
6	Udhwa	Udhwajil	WRD	GS
7	Rajmahal	Ganga	WRD	GS
8	Saxenaghat	Ganga	WRD	GS
9	Sahebganj	Ganga	WRD	GS

2.10 Mayurakshi and other Adjoining Streams River Basin

2.10.1 Salient features of the river basin

The salient features of the river basin are as follows:

- The Mayurakshi and other adjoining streams river basin is situated between latitudes $23^0$48' N and $24^0$57' N and longitudes $86^0$45' E and $86^0$30' E.
- The total geographical area of the basin is 5710 sq. km. of which 1520 sq. km. falls in Sahebganj district, 3080 sq. km. in Dumka district, 280 sq. km. in Deoghar district and 110 sq. km. in Godda district.
- The basin covers 36.52 percent of Sahebganj district, 68.72 percent of Dumka district, 11.35 percent of Deoghar district and 4.6 percent of Godda district.
- As per the 1991 Census Report, the population of the basin is 15.72 lakh, the intensity of the population being 275 persons per sq. km.

2.10.2 The river system

The river Mayurakshi originates from Trikuti hills in Deoghar district in Bihar at an altitude of 610 m above MSL and outfalls in Bhagirathi in West Bengal. The other important streams of the basin are the *Dwarka*, the *Brahmani*, the *Tripta*, the *Paglan*, the *Bansoli*, the *Torai* and the *Kanli*. These streams join Mayurakshi in West Bengal.

2.10.3 Land use pattern in the basin

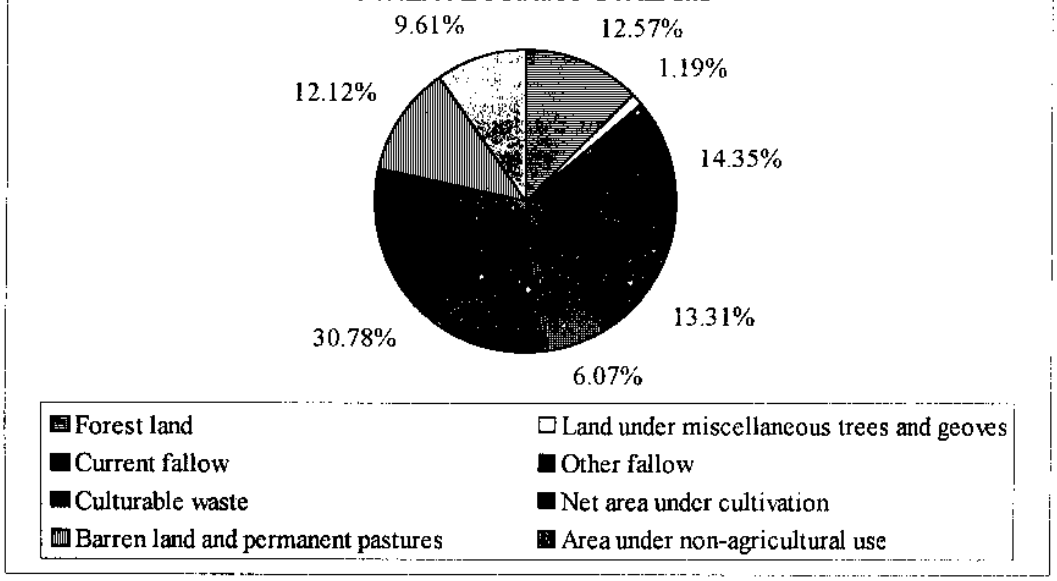
Fig. 2.10 shows the land use pattern of Mayurakshi and other adjoining streams river basin.

2.10.4 Soils in the basin

This basin comprises the following categories of soils:

- Hills and forest soil of steep slopes and highly dissected region. This category of soil exists in the central part of the basin starting from north with broader side and gradually narrowing towards south.

FIG. 2.10 LAND USE PATTERN IN BASINS OF MAYURAKSHI AND OTHER ADJOINING STREAMS



- Tal land soil light-grey, dark-grey medium in heavy textured soil. This category of soil is found in a strip at the north eastern corner of the basin. The strip extends from north to south.
- Upland grey, yellowish grey heavy soil on sedimentary and allied rocks. A strip of land on the extreme south border of the basin belongs to this category.
- Old alluvium yellowish-red, yellow soils of foot hills. A wide patch of land exending from north to south on eastern side of the basin belongs to this category of soil.

2.10.5 Rainfall

The average annual rainfall is about 138 cm of which about 80 percent occurs during monsoon months from June to September.

2.10.6 Surface and ground water potential

Surface water potential of the river basin is 2287.8 MCM which is equivalent to 40 cm of waterspread over the entire basin while the ground water potential is 445.4 MCM.

2.10.7 Gauge and discharge sites in the basin

Table 2.7 lists the different gauge and discharge sites in Mayurakshi and other adjoining streams river basin.

Table 2.7 List of Gauge and Discharge Sites in Mayurakshi and other Adjoining Streams River Basin

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
1	Bishunpur	Tepra	WRD	FM
2	Kumir Khala	Nunubil	WRD	FM
3	D.S.Dumka	More	WRD	FM
4	Bijaypur	More	WRD	FM
5	Phulopani	Bhurbhuri	WRD	FM
6	Ratanpur	Brahimini	WRD	FM
7	Haripur	Brahimini	WRD	FM
8	Kathikund	Brahimini	WRD	FM
9	Dhankuta	Brahimini	WRD	FM
10	Domanpur	Brahimini	WRD	FM
11	Rajdaha	Brahimini	WRD	FM
12	Maharo	Mayurakshi	CWC	CMG
13	Masanjore dam	Mayurakshi	CWC	CMG
14	Maheshpur	Bansloi	WRD	FM

2.11 Ajay River Basin

2.11.1 Salient features of the river basin

The salient features of the river basin are as follows:

- The Ajay river basin is situated between latitudes $24^0$6' N and $23^0$50' N and longitudes $86^0$16' E and $87^0$5' E.
- The total geographical area of the basin in Bihar is 3553.65 sq. km. of which 1890.41 sq. km. falls in Deoghar district, 379.94 sq. km. in Giridih district, 956.66 sq. km. in Dumka district and 326.64 sq. km. in Munger district.
- In Bihar, the basin covers 76.27 percent of Deoghar district, 17.28 percent of Dumka district, 5.10 percent of Munger district and 5.58 percent of Giridih district.
- As per the 1991 Census Report, the population of the basin is 11.67 lakh, the intensity of the population being 328 persons per sq. km.

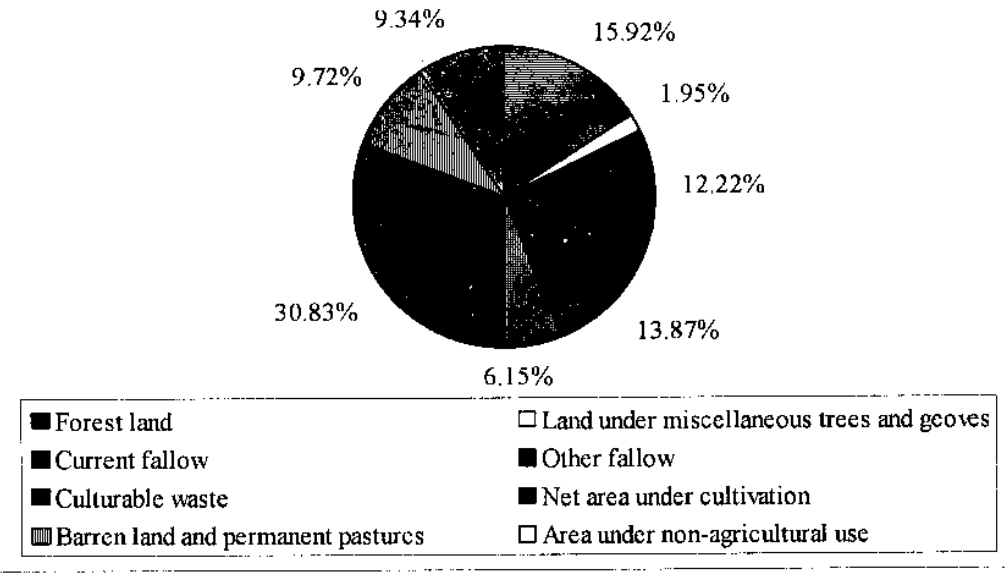
2.11.2 The river system

Ajay river originates from the hills in Chakai block of Munger district. It flows in South-east direction for a length of 132 km in Bihar and 144 km in West Bengal before falling into the river Bhagirathi near Katwa. It leaves the hilly terrain near Punasi and after passing through Rohini near Deoghar it receives its first important tributary on the left namely the *Darua*, south of Deoghar. The river further goes down via Sarath where it confluences with a major tributary *Pathro*. At 11 km from Sarath another main tributary *Jayanti* joins Ajay near Sikatia. The river leaves Bihar near Chittaranjan which is about 15 km below Jamtara.

2.11.3 Land use pattern in the basin

Fig. 2.11 shows the land use pattern of Ajay basin.

FIG. 2.11 LAND USE PATTERN IN AJAY BASIN



2.11.4 Soils of the basin

The soils in the Ajay river basin have been almost entirely derived from granite gneiss and schists and are mostly yellow and red at the surface except in low lands where olive to olive grey soils may also be discerned. Most of these soils are sandy and loamy sand specially on uplands, and are, therefore, very light at the surface. But in lowlands medium textured sandy loam to loam soils are encountered.

This basin comprises the following categories of soils:

- Pale yellow, yellow, pinkish deep catenary soils on micaceous schists. This exist in north western tip of the basin in a small patch.
- Red, yellow, light grey catenary soils. Major part of the basin in the north central and east central and east consists of this soils.
- Reddish yellow, yellow, greyish yellow, deep catenary soils of coal belt. This soil exists in the southern part of the basin.

2.11.5 Rainfall

The average annual rainfall is about 138 cm of which about 80 percent occurs during the monsoon period from June to September.

2.11.6 Surface and ground water potential

Surface water potential of the river basin is 1238.7 MCM which is equivalent to 34.85 cm of waterspread over the entire basin while the ground water potential is 253 MCM.

2.11.7 Gauge and discharge sites in the basin

Table 2.8 lists the different gauge and discharge sites in Ajay basin.

Table 2.8 List of Gauge and Discharge Sites in Ajay Basin

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
1	Marrow	Rajoiya	WRD	FM
2	Loharjori	Badgari	WRD	FM
3	Tilbenia	Beri	WRD	FM
4	Burhai	Pathrow	WRD	FM
5	Jamtara	Ajay	WRD	FM
6	Dhakwa	Jayanti	WRD	FM
7	Gandhi Tanr	Darua	WRD	FM
8	Sarath	Ajay	WRD	FM
9	Loharjor	Bagdaraw	WRD	FM
10	Sikitia	Ajay	CWC	GS
11	Jamtara	Ajay	CWC	CMG
12	Sanhaula	Gaira	WRD	FM

2.12 Sankh River Basin

2.12.1 Salient features of the river basin

The salient features of the river basin are as follows:

- The Sankh river basin is situated between latitudes $22^0 0'$ N and $23^0 17'$ N and longitudes $83^0 55'$ E and $84^0 46'$ E.
- The total geographical area of the basin in Bihar is 4027.43 sq. km. of which 4017.86 sq. km. falls in Gumla district, and 9.57 sq. km. in Palamu district.
- In Bihar, the basin covers 44.27 percent of Gumla district and 0.08 percent of Palamu district.
- As per the 1991 Census Report, the population of the basin is 4.57 lakh, the intensity of the population being 114 persons per sq. km.

2.12.2 The river system

The river Sankh originates from hills of Chainpur block of Gumla district at an elevation of 1020 m. It outfalls into the South Koel in Orissa which is called Brahmani in lower reaches. The main tributaries of the Sankh are *Jhikdah*, *Basa*, *Chirra*, *Bandanijor* and *Dongojor* from right side and *Saphi*, *Kodari*, *Palamara*, *Chhinda* and *Lurgi* on the left.

2.12.3 Land use pattern in the basin

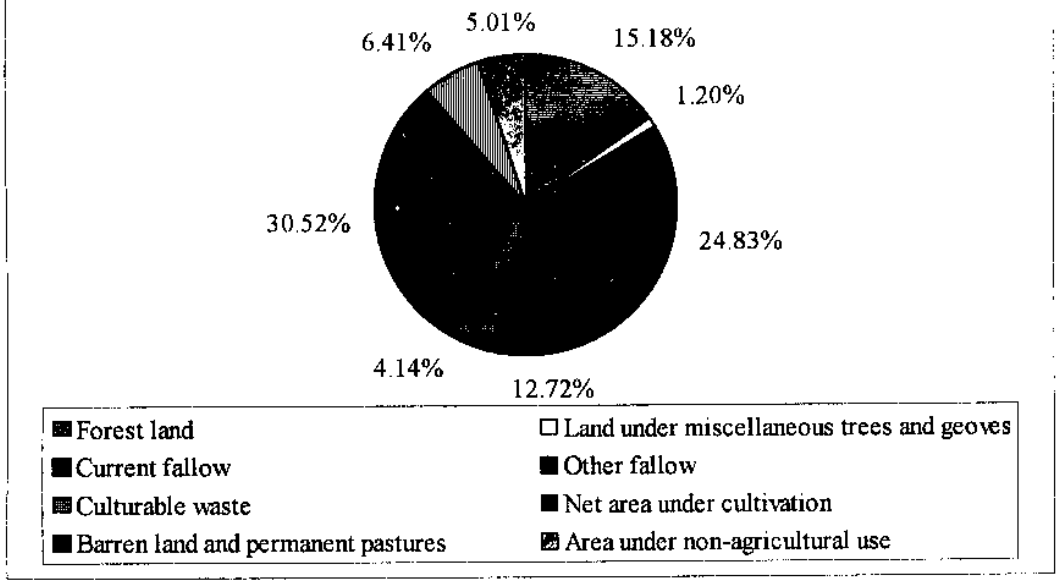
Fig. 2.12 shows the land use pattern of Sankh basin.

2.12.4 Soils in the basin

This basin comprises the following category of soils:

- Hill and forest soils of steep slopes and highly dissected regions. This soil exists in the north western part of the basin.
- Yellow, reddish-yellow, medium, deep, light textured catenary soil. This category of soil exists in whole of the basin except north western part.

FIG. 2.12 LAND USE PATTERN IN SANKH BASIN



2.12.5 Surface and ground water potential

Surface water potential of the river basin is 1547 MCM which is equivalent to 38.4 cm of waterspread over the entire basin while the ground water potential is 319 MCM.

2.12.6 Gauge and discharge sites in the basin

Table 2.9 lists the different gauge and discharge sites in Sankh basin.

Table 2.9 List of Gauge and Discharge Sites in Sankh Basin

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
1	Rajbasa Dam Site	Keshargarh	WRD	FM
2	Harapani Dam Site	Lumbani	WRD	FM
3	Khalijore Dam Site	Khalijore	WRD	FM
4	Palemura Dam Site	Dongajor	WRD	FM
5	Suali Dam Site	Lafari	WRD	FM
6	Khanjlyalya Dam Site	Kasijore	WRD	FM

2.13 South Koel River Basin

2.13.1 Salient features of the river basin

The salient features of the river basin are as follows:

- The South Koel river basin is situated between latitudes $22^0$15' N and $22^0$32' N and longitudes $84^0$30' E and $85^0$45' E.
- The total geographical area of the basin in Bihar is 10588.56 sq. km. of which 4016.03 sq. km. falls in Gumla district, 2370.10 sq. km. in Ranchi district, 8912.9 sq. km. in Lohardagga district and 3311.14 sq. km. in West Singhbhum district.
- In Bihar, the basin covers 44.24 percent of Gumla district, 31.29 percent of Ranchi district, 59.78 percent of Lohardagga district and 34.49 percent of West Singhbhum district.
- As per the 1991 Census Report, the population of the basin is 16.33 lakh, the intensity of the population being 155 persons per sq. km.

2.13.2 The river system

The river South Koel originates from Chotanagpur hills at an elevation of about 730 m near village Nagri, 16 km west of Ranchi township. It joins river Sankh near Rourkela in Orissa and beyond this the river is known as the Brahmani which outfalls in the Bay of Bengal. The rivers like *Bambhani*, *Nandini*, *Kans*, *Arraiya*, *Paras*, *North Karo* and *South Karo* are its left bank tributaries while *Sapahi*, *Surkhi*, *Phuljhar*, *Barka*, *Banki* (north), *Katwa*, *Kulebira*, *Marda* and *Topra* meet the river on its right bank. Of all these tributaries, the river North Karo and South Karo are its main tributaries in Bihar.

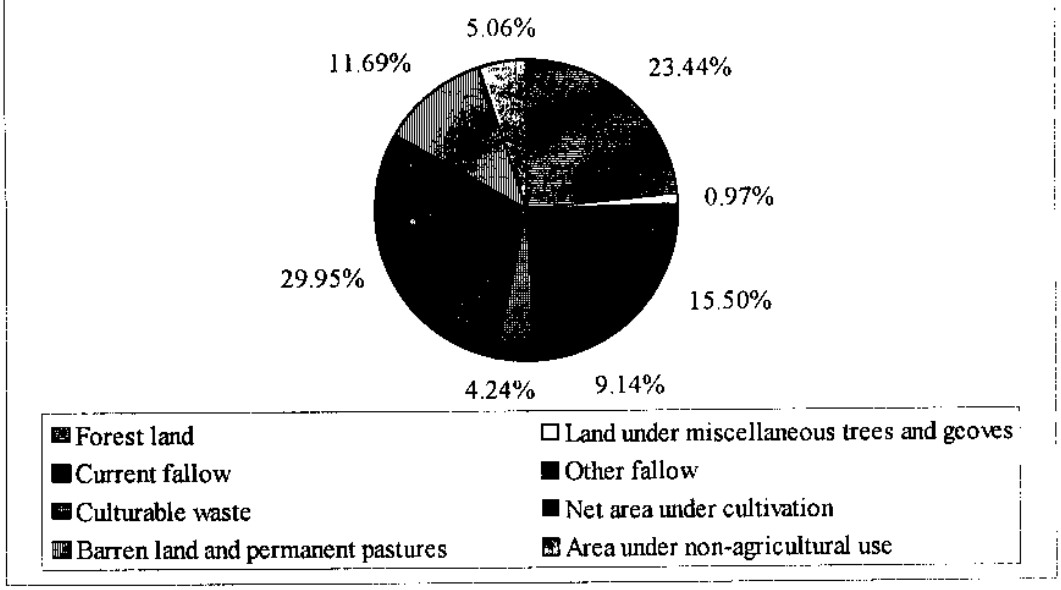
2.13.3 Land use pattern in the basin

Fig. 2.13 shows the land use pattern of South Koel basin.

2.13.4 Soils in the basin

This basin comprises the following category of soils:

FIG. 2.13 LAND USE PATTERN IN SOUTH KOEL BASIN



- Hill and forest soils of steep slopes and highly dissected regions. This soil exists in north western, central north and central south part of the basin in small patches.
- Yellow, reddish-yellow medium deep light textured catenary soils. A vast area in the western and south western part of the basin consists of this category of soil.
- Upland grey, yellowish-grey, heavy soils on sedimentary and allied rocks. This soil exists in major part of the basin occupying the eastern and the west northern portion.
- Red yellow-chocolate soils of iron ore region. This soil exists in small patch in north eastern tip of the basin and also in extreme south western and south eastern portion.

2.13.5 Surface and ground water potential

Surface water potential of the river basin is 4030 MCM which is equivalent to 38.1 cm of waterspread over the entire basin while the ground water potential is 694 MCM.

2.13.6 Gauge and discharge sites in the basin

Table 2.10 lists the different gauge and discharge sites in South Koel basin.

Table 2.10 List of Gauge and Discharge Sites in South Koel Basin

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
1	Dumartoli	Pokta	WRD	FM
2	Dhauratoli	Parasnala	WRD	FM
3	Matukdih	Marda	WRD	FM
4	Kalhatoli	Deo	WRD	FM
5	Gorkho Dam Site	Birgore	WRD	FM
6	Tati Dam Site	Tati	WRD	FM
7	Shringda	Koel-Karo	WRD	FM
8	Kanti R. S.	Chhata	WRD	FM
9	Lisimoti	Deo	WRD	FM
10	Karanjtoli D. S.	Trib of Karo	WRD	FM
11	Manoharpur	S. Koel	WRD	FM
12	Gudri D. S.	Karo	WRD	FM
13	Mamail	Roro	WRD	FM

2.14 Barakar River Basin

2.14.1 Salient features of the river basin

The salient features of the river basin are as follows:

- The Barakar river basin is situated between latitudes $23^0$43' N and $24^0$31' N and longitudes $85^0$7' E and $86^0$53' E.
- The total geographical area of the basin is 7026 sq. km. of which 2205.75 sq. km. falls in Hazaribagh district, 209.5 sq. km. in Chatra district, 453.23 sq. km. in Bokaro district, 695.7 sq. km. in Dhanbad district, 487.11 sq. km. in Dumka district and 2974.71 sq. km. in Giridih district.
- The basin covers 21.77 percent of Hazaribagh district including Chatra district, 38.05 percent of Dhanbad district including Bokaro district, 8.8 percent of Dumka district and 43.67 percent of Giridih district.
- As per the 1991 Census Report, the population of the basin is 23.24 lakh, the intensity of the population being 331 persons per sq. km.

2.14.2 The river system

The Barakar river originates from the hills of Hazaribagh and runs almost parallel to river Damodar in about 200 km length in the eastern direction and joins the river Damodar near Dishergarh town. The important tributaries of the river Barakar are the *Saghar*, the *Barakar Sakri*, the *Barsati*, the *Khero*, the *Bakra*, the *Igra*, the *Usri*, the *Chikri*, the *Khudia*, the *Beri* and the *Rajoya*.

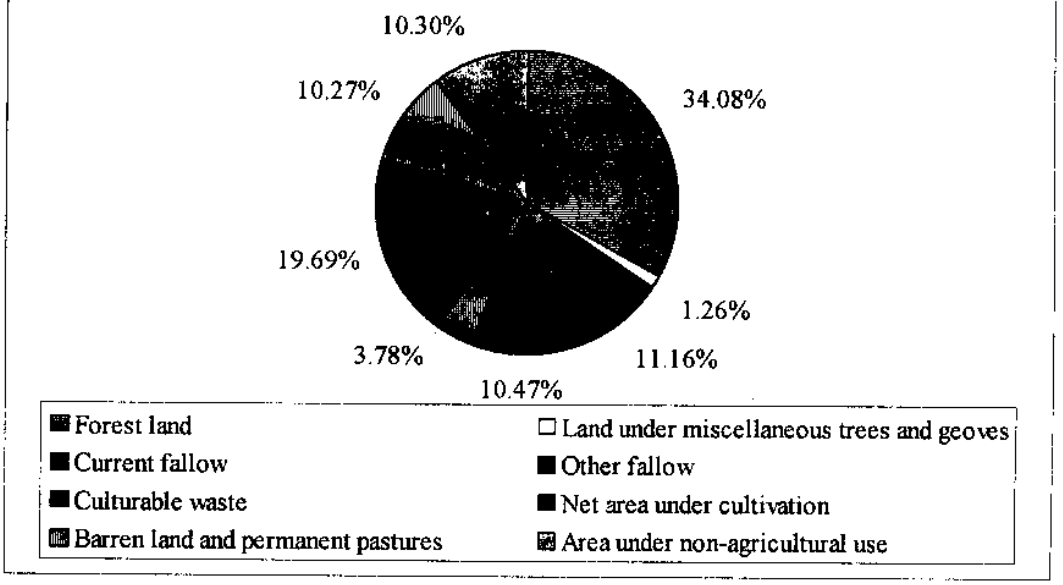
2.14.3 Land use pattern in the basin

Fig. 2.14 shows the land use pattern of Barakar basin.

2.14.4 Soils of the basin

This basin comprises of the following soil associations:

FIG. 2.14 LAND USE PATTERN IN BARAKAR BASIN



- Reddish yellow-yellow-greyish yellow deep catenary soils of coal belt. This category of soil exists in whole of north west, central part of the basin.
- Upland grey yellowish grey heavy soil on sedimentary and allied rocks. This category of soil is found in the north east corner of the basin.

2.14.5 Surface and ground water potential

Surface water potential of the river basin is 2400 MCM which is equivalent to 34.15 cm of waterspread over the entire basin while the ground water potential is 510.0 MCM.

2.14.6 Gauge and discharge sites in the basin

Table 2.11 lists the different gauge and discharge sites in Barakar and Damodar basin.

Table 2.11 List of Gauge and Discharge Sites in Barakar and Damodar Basin

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
1	Jamunia Taur.	Gandwa	WRD	FM
2	Upper Usri R. S.	Usri	WRD	FM
3	Lower Usri (Parsatar)	Usri	WRD	FM
4	Bakaia	Usri	WRD	FM
5	Person (Parsatar)	Chargatta	WRD	FM
6	Harla-Tand	Kenarinala	WRD	FM
7	Gundwa R. S.	Gundwanala	WRD	FM
8	Near Dam axis (Middle Usri)	Usri	WRD	FM
9	Narayanpur & Jamtara	Rajoiya	WRD	FM
10	P.W.D. Road crossing point Narayanpur	Rajoiya	WRD	FM
11	Dam-axis (Mohanpur)	Rajoiya	WRD	FM
12	Dam-axis (Parsatar)	Sitanala	WRD	FM
13	Sita-nala R. S.	Khababara nala	WRD	FM
14	Badalpur	Berinala	WRD	FM
15	Koriao (Beri nala R. S.)	Damgari	WRD	FM
16	Karhni	Barakar	WRD	FM
17	Hajoya R. S. (Dam axis)	Gandia nala	WRD	FM
18	Minga	Khanja	WRD	FM
19	Darwa	Khalisa	WRD	FM
20	Khetahar	Khudia	WRD	FM
21	Barajeri	Tasarkua	WRD	FM
22	Basantpur	Gobai	WRD	FM
23	Damodih	Dhinala	WRD	FM

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
24	Pindarkom	Ramghat	WRD	FM
25	Navokhap	Hathberwa	WRD	FM
26	Taria G. S.	Taria	WRD	FM
27	Dam site	Kutulwa	WRD	FM
28	Dam site	Dekuli	WRD	FM
29	Barwa	Siwane	WRD	FM
30	Kanki	Maraharha	WRD	FM
31	Dam site	Sakari	WRD	FM
32	Ramgarh	Damodar	WRD	FM
33	Karnpura	Damodar	WRD	FM
34	Chas	Damodar	WRD	FM
35	Lariadih	Akte	WRD	FM
36	Kelgama	Harharo	WRD	FM
37	Kanki	Barsoti	WRD	FM
38	Durgargi	Irga	WRD	FM
39	Loharaga	Sitanala	WRD	FM
40	Barhi	Barakar	WRD	FM
41	Dhanwar	Barakar	WRD	FM
42	Palganj	Barakar	WRD	FM
43	Hindegir	Damodar	CWC	GS
44	Ramgarh	Damodar	CWC	GS
45	Tenughat Dam	Damodar	CWC	CMG
46	Panchet Dam	Damodar	CWC	CMG
47	Bhanaran	Damodar	CWC	CMG
48	Konar Dam	Konar	CWC	CMG

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
49	Nandadih	Barakar	CWC	CMG
50	Barki Sariya	Barakar	CWC	CMG
51	Tilaiya Dam	Barakar	CWC	CMG
52	Maithan Dam	Barakar	CWC	CMG
53	Parariya	Beri nala	WRD	FM
54	Furukagalgera	Furuka	WRD	FM
55	Marmarha	Marmarha	WRD	FM
56	Bhaisa-Dam	Rahera	WRD	FM
57	Ganeshpur	Dagdagia	WRD	FM
58	Koso	Patalsuc	WRD	FM
59	Kutulwa	Dhordhurwa	WRD	FM
60	Hahe G. S.	Rajhar	WRD	FM

2.15 Damodar River Basin

2.15.1 Salient features of the river basin

The salient features of the river basin are as follows:

- The Damodar river basin is situated between latitudes $23^0$22' N and $24^0$8' N and longitudes $84^0$37' E and $86^0$50' E.
- The total geographical area of the basin is 9907.8 sq. km. of which 658.25 sq. km. falls in Palamu district, 109.21 sq. km. in Lohardagga district, 1368.11 sq. km. in Bokaro district, 501.96 sq. km. in Dhanbad district, 405.02 sq. km. in Chatra district, 3588.6 sq. km. in Hazaribagh district, 1066.66 sq. km. in Ranchi district, 2209.99 sq. km. in Giridih district.
- The basin covers 5.28 percent of Palamu district, 7.33 percent of Lohardagga district, 61.94 percent of Dhanbad district including Bokaro, 14.08 percent of Ranchi district, 35.99 percent of Hazaribagh district including Chatra and 32.44 percent of Giridih district.
- As per the 1991 Census Report, the population of the basin is 49.28 lakh, the intensity of the population being 497 persons per sq. km.

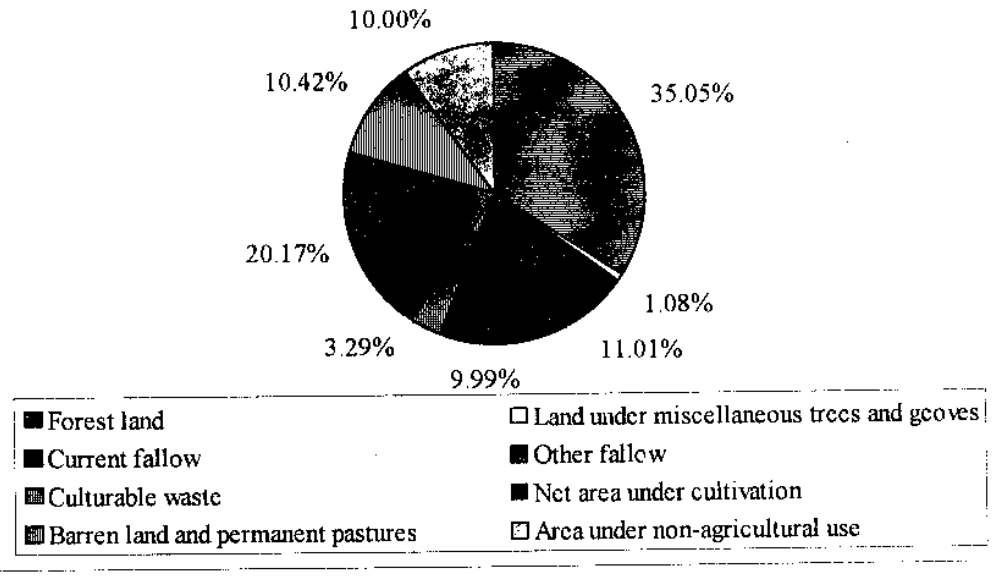
2.15.2 The river system

The river Damodar originates from the hills of south-east corner of the Palamu district of Bihar at an elevation of 600 m and outfalls in the river Bhagirathi in West Bengal near Calcutta. The right bank tributaries of the river Damodar are *Sapahi*, *Bhera*, *Isri* and *Gowai* while the left bank tributaries are *Bokaro*, *Konar*, *Jamunia* and *Barakar*, the last one being the most important.

2.15.3 Land use pattern in the basin

Fig. 2.15 shows the land use pattern of Damodar basin.

FIG. 2.15 LAND USE PATTERN IN DAMODAR BASIN



2.15.4 Soils of the Basin:

The following category of soils are found in the basin:

- Hill and forest soils of steep slopes and highly dissected region. This category of soil exists in central and central-western portion of the basin in two patches.
- Reddish yellow, yellow, greyish yellow deep catenary soils of coal belt. This category of soil exists in northern and in the southern part of the basin.
- Upland grey-yellowish grey heavy soils on sedimentary and allied rocks in this type of soil is found in a big stretch of land starting from centre of the basin and ending at the eastern boundary of the basin.
- Red yellow-chocolate soils of iron ore region. This category of soil exists in north western part of the basin.

2.15.5 Rainfall

The average annual rainfall is about 148 cm of which about 80 percent occurs during the monsoon period from June to September. The maximum value of 24 hours rainfall of 50 years frequency is 24 cm measured near the West Bengal border.

2.15.6 Surface and ground water potential

Surface water potential of the river basin is 3400 MCM which is equivalent to 34.3 cm of waterspread over the entire basin while the ground water potential is 721 MCM.

2.15.7 Nature of hydrological problem

Problems of soil erosion from forest areas and barren lands and deposition of soils in the dam sites are of serious concern.

2.16 Subarnarekha-Kharkai River Basin

2.16.1 Salient features of the Subarnarekha river basin

The salient features of the river basin are as follows:

- The Subarnerekha river basin is situated between latitudes $22^0$0' N and $23^0$31' N and longitudes $85^0$7' E and $86^0$46' E.
- The total geographical area of the basin is 8591.46 sq. km. of which 4097.81 sq. km. falls in Ranchi district, 1067.61 sq. km. in West Singhbhum district, 2794.02 sq. km. in East Singhbhum district and 92.02 sq. km. in Hazaribagh district.
- The basin covers 79.07 percent of East Singhbhum district, 16.26 percent of West Singhbhum district, 54 percent of Ranchi district and 0.83 percent of Hazaribagh district.

2.16.2 The Subarnarekha river system

The Subarnarekha river originates from village Bandhea 15 km south-west of Ranchi at an elevation of 720 m and falls in the Bay of Bengal after traversing through Bihar, West Bengal and Orissa. Its total length is about 395 km from origin to the outfall. Out of this, the length in Bihar is about 269 km. The important right bank tributaries of the river Subarnarekha are the rivers *Raru*, *Kanchi*, *Karkai*, *Kharkai*, *Gara Nala* and *Sankha Nala* and the left ones are *Jumar* and *Sank*.

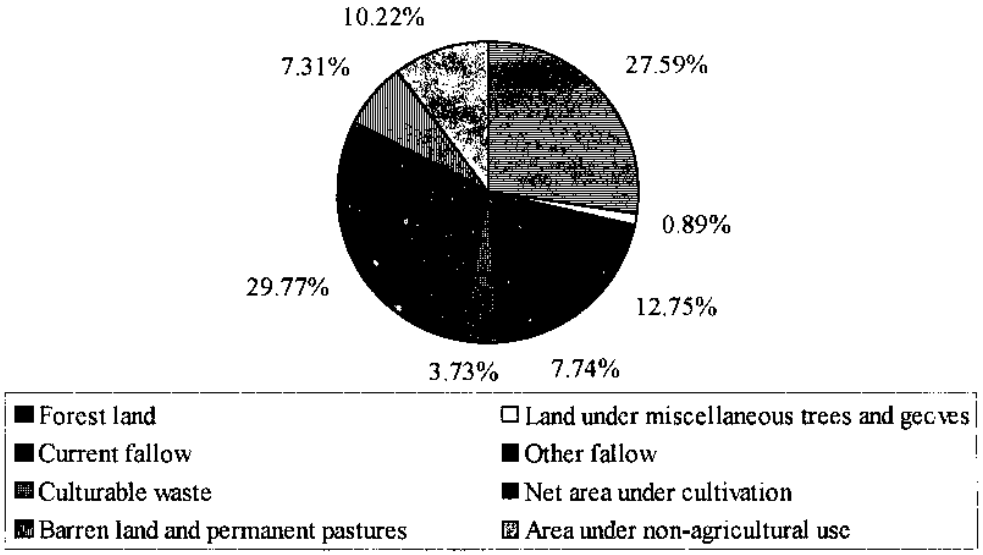
2.16.3 Land use pattern in Subarnarekha basin

Fig. 2.16 shows the land use pattern of Subarnarekha basin.

2.16.4 Surface and ground water potential of Subarnarekha basin

Surface water potential of the river basin is 3232 MCM while the ground water potential is 634 MCM.

FIG. 2.16 LAND USE PATTERN IN SUBERNAREKHA BASIN



2.16.5 Gauge and discharge sites in the basin

Table 2.12 lists the different gauge and discharge sites in Subernarekha basin.

Table 2.12 List of Gauge and Discharge Sites in Subarnarekha Basin

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
1	Illigar R. S.	Illigara	WRD	FM
2	Bhagabandi	Goranala	WRD	FM
3	Baranala R. S.	Baranala	WRD	FM
4	Raru Res. Scheme	Raru	WRD	FM
5	Tajna Res. Scheme.	Tajna	WRD	FM
6	Raisa Head Work	Raisa	WRD	FM
7	Bijay Dam Site	Bijay	WRD	FM
8	Bamini Res. Site	Bamini	WRD	FM
9	Kanchi Res. Site (Kujaram)	Kanchi	WRD	FM

Sl. No.	Station (Name of Site)	Stream	Maintained by	Method
10	Silda Dam Site	Kanchi	WRD	FM
11	Kaida Dam Site	Sanjai	WRD	FM
12	Chandil Dam Site	Subarnarekha	WRD	FM
13	Sarjan Hatu R. S.	Sarjainala	WRD	FM

2.16.6 Salient features of the Kharkai river basin

The salient features of the river basin are as follows:

- The Kharkai river basin is situated between latitudes $22^0$0' N and $22^0$45' N and longitudes $86^0$13' E and $86^0$25' E.
- The total geographical area of the basin in Bihar is 4206.02 sq. km. of which 39.08 sq. km. falls in Ranchi district, 12.63 sq. km. in East Singhbhum district and 4154.31 sq. km. in West Singhbhum district.
- The basin covers 0.52 percent of Ranchi district, 42.01 percent of West Singhbhum district and 0.36 percent of East Singhbhum district.

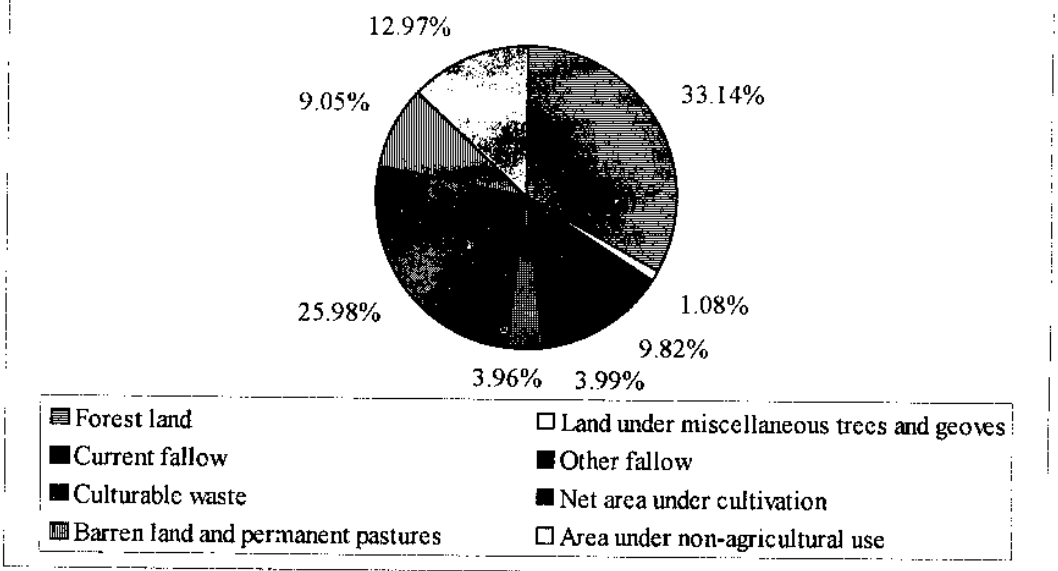
2.16.7 The river system

The river Kharkai originates from the hills of Simlipal forest in Orissa and falls in river Subarnarekha near Adityapur in Jamshedpur. The river Kharkai having a total length of 166 km flows for a length of 55 km in Orissa and then 13 km along the border of the two states and rest 98 km in Bihar.

2.16.8 Land use pattern in Kharkai basin

Fig. 2.17 shows the land use pattern of Kharkai basin.

FIG. 2.17 LAND USE PATTERN IN KHARKAI BASIN



2.16.9 Surface and ground water potential of Kharkai basin

Surface water potential of the river basin is 1085 MCM while the ground water potential is 242 MCM.

2.16.10 Soils in the composite basin

This composite basin comprises the following soil associations:

- Hill and forest soils of steep slopes and highly dissected regions. This category of soil is spread over southern part of the basin and includes Murhu, Erki, Tamar and Chandil blocks. Some small patches of such soil also also exists between Nimdih and Jamshedpur, east of Ghatsila, west and south of Musabani.
- Reddish-yellow, yellow, grayish-yellow deep catenary soils of coal belt. This category of soil exists in north west and central zone of the basin.
- Mixed red yellow-black catenary soils of Singhbhum. This category of soil exists in central eastern part of basin around Jamshedpur.
- Red yellow ground water laterite soils. This category of soil exists extreme south-east of the basin around Chakulia and Baharagora.

2.17 River Basins of Small Streams Draining Independently Outside the State

These river basins lie on the fringe of Sankh, South Koel and Subernarekha river basins and is drained through small streams flowing to the neighbouring states namely Orissa and West Bengal. These streams finally join the Brahmani river in Orissa and Kasai river in West Bengal.

2.17.1 Salient features of the river basins

The salient features of the river basins are as follows:

- The total geographical area of the basins in Bihar is 1684.68 sq. km. of which 142.67 sq. km. falls in Gumla district, 815.37 sq. km. in West Singhbhum district and 726.84 sq. km. in East Singhbhum district.
- The basin covers 1.57 percent of Gumla district, 8.24 percent of West Singhbhum district and 20.57 percent of East Singhbhum district.
- As per the 1991 Census Report, the population of the basin is 3.28 lakh, the intensity of the population being 195 persons per sq. km.

2.17.2 Land use pattern in the basins

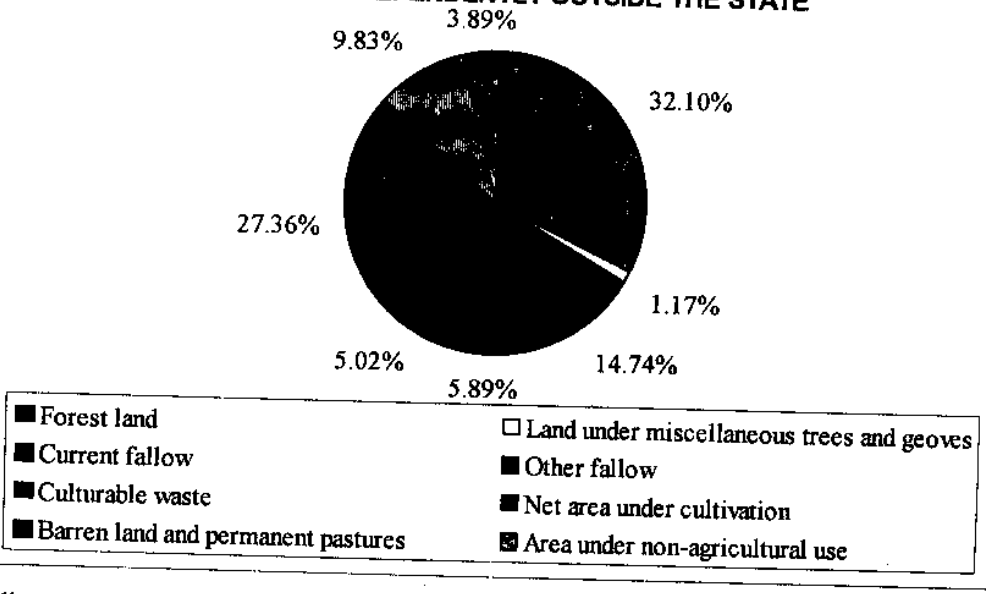
Fig. 2.18 shows the land use pattern of river basins which drain independently outside the state.

2.17.3 Soils of the basin

In this zone the following category of soils are found:

- Hill and forest soils of steep slopes and highly dissected regions. This category of soil exists in a narrow strip in southern portion of the basin and in small patch at eastern fringe of the basin.
- Red yellow, chocolate soils of iron ore region. This category of soil is found at the southern tip of the basin.

FIG. 2.18 LAND USE PATTERN IN BASINS OF SMALL STREAMS FLOWING INDEPENDENTLY OUTSIDE THE STATE



- Yellow, reddish yellow, deep medium, light textured catenary soil. This category of soil exists at the south western tip of the basin.
- Mixed red yellow black catenary soil of Singhbhum. This category of soil is found in patches at the eastern fringe of the basin.
- Red yellow ground water laterite soil. The south-eastern tip of basin comes under this category of soil.

2.17.4 Surface and ground water potential

Surface water potential of the river basin is 2793 MCM which is equivalent to 51 cm of waterspread over the entire basin while the ground water potential is 1561.8 MCM.

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