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WATER LOGGING AND DRAINAGE CONGESTION PROBLEM IN MOKAMA TAL AREA, BIHAR, GPRC

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PREFACE

An area is considered to be water logged when its crop productivity is affected by high water table, causing adverse effect in the root zone of the plant. Water logging or drainage congestion is mainly caused by improper planning of flood management works and other infrastructural development works like road, canal, embankments etc. and faulty water management practices. Construction of various structures impede the natural flow of the rivers/drains etc. and may cause drainage congestion in the adjoining area. Over irrigation from canals in agricultural land may cause excessive percolation and consequent rise in ground water table, effecting thereby the root zone of the plant. For the problems of water logging and drainage congestion in an area lined canal, impervious obstructions, impermeable soil strata, inadequate natural drainage and irregular or flat topography are also responsible.

Total flood prone area in the country is estimated as 400 lac. hectares. Bihar state which covers one-nineteenth territory and one-tenth of the total population of the country itself constitutes 64.6 lac. hactare i.e. 16 % of total flood prone area. The problem of drainage congestion and water logging has been projected as a very serious one by both the State Government and expert group of committee appointed by government time to time. In the state nearly 9 lac hectares area is facing the problem of water logging and drainage congestion out of which 8.00 lac hectare lie in North Bihar and 1.00 lac hectares in Central Bihar. Area adjoining south of the river Ganga from Patna to Lakhisarai in a length of 100 kms and width of 6 to 7 km, consists of 7 Tals (low lying pockets). This area is popularly known as Mokama Tal. During monsoon months almost all the Tal gets filled up with water. This hampers optimum utilisation of land resources of Tal particularly during Kharif season. When the Tal gets drained out by its natural drainage by mid October, a bumper rabi crop is grown almost in the entire Tal area, depending on the availability of residual moisture in the soil.

Study of water logging and drainage problems in Mokama Tal area has been suggested by the Bihar State Irrigation Department. For preparation of this report the

publications/ reports/ data available in Water Resources Department, Patna, WALMI, Patna, GFCC, Patna, CWRS, Bihar College of Engineering, Patna etc. have been made use of. THe institute express sincere thanks to these organisations for making available the necessary data/information for including in this publication.

The present study describes in detail the problem of water logging in Mokama Tal area, its hydrological and topographical features, status of various studies and schemes etc. This report has been prepared by Sri A.K. Lohani, S.A. "B" and R.K. Jaiswal, "S.R.A." under the guidance of Dr. A.V.S. Bhatia, Head & Coordinator, Ganga Plains Regional Centre, Patna.

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ABSTRACT

Water logging refers to the condition of an agricultural land in which it can not be put to its normal use as a result of either or both of high water table and surface ponding. The water logging condition takes place due to surface flooding and rise in ground water table. The surface water logging may occur due to stagnation of surface water as a result of low infiltration rate of the soil as compared to rainfall intensities and inadequate surface drainage. The rise in ground water table is on account of existing initially high ground water level, high water flow into the soil through infiltration, exfiltration of ground water as a result of stagnating subsurface flow and poor vertical as well as horizontal drainage.

In Bihar the drainage congestion and water logging problem exist in manifest mainly in the direct form of surface water stagnation. The Mokama Tal area is richly endowed with abundant fertile soil. Its great potential of land resource is remain underutilised due to submergence during monsoon. Continued submergence in most of the Tal hampers the cultivation of Kharif crop in a vast area. If somehow drainage of the Tal delays the Rabi crop also suffers due to delayed sowing and loss of soil moisture when it approaches to the stage of maturity. There are

various reasons for the long felt problem of Tal area. In the present study a brief description the Mokama Tal area, river system, geology and landuse has been given. The report explains in detail the nature and extent of water logging problem in Tal area, recommendations of various experts/ committees and the status of remedial measures adopted and achieved.

1.0 INTRODUCTION

According to Bureau of Indian Standard (BSI) "*water logging (Is11493-1986) refers to the condition of land in which it can not be put to its normal use as a result either or both of high water table and surface ponding. In arable lands depending upon the extent and duration of water logging the crop yield may reduce substantially or even become zero*". The Central Board of Irrigation and Power has defined water logging as "*An area is said to be water logged when the water table rises, to an extent that the soil pores in the root zone of a crop, become saturated, resulting in restriction of the normal circulation of air, decline in the level of oxygen and increase in the level of corbon-dioxide. The water table, which is considered harmful, would depend upon the type of crop, type of soil and quantity of water. The actual depth of water table, when it starts affecting the yield of the crop adversely, may vary over a wide range from zero for rice to about 1.5 mts for other crops*". The most damaging effect of water logging is manifest in the loss of agriculture production which may vary from about 50% to 100% of normal production depending upon the type of crop, nature and severity of problem.

Out of about 329 m.ha. geographical area of the country

about 140 m.ha (about 46%) is only under cultivation and further horizontal expansion is rather a remote possibility. Moreover, an area of around 144 m.ha is suffering from water and wind erosion and about 29 m.ha from special problem of water logging, excessive salt concentration etc. (Aggrawal & Dinkar, 1990). In India the first survey of water logged area was done in 1972 by Irrigation Commission. National Commission on Agriculture, Central Groundwater Board, Ministry of Agriculture etc. have also given figures about total water logged area in India (Table 1.1). Figures for water logging in different States as given by Irrigation Commission, National Commission on Agriculture (1976) and Ministry of Agriculture (1990) are presented in Table 1.2. It is seen from the Table 1.1 and Table 1.2 that different agencies have given different figures of water logged area in India. The data (Table 1.2) show that the problem of water logging is more pronounced in West Bengal, Uttar Pradesh, Punjab, Bihar etc. In Bihar, drainage has received much less attention than it should have. Major projects such as Kosi and Gandak were formulated apparently without adequate consideration of drainage problems (Sinha, 1992). The river Ganga flows from west to east in the central part of Bihar. Most of the rivers originating from south Bihar join the river Ganga. These rivers have steep slope in the

Table 1.1 **Water logged area in India according to different studies**

S. No.	Year	Agency undertaking study	Water logged area in million ha	Water logged area as % of irrigated area
1.	1972	Irrigation Commission	4.840	12.2
2.	1976	National Commission on Agriculture	5.986	13.2
3.	1982	Central Ground Water	3.423	6.1
4.	1984	Administrative Staff College of India - R.Bowander and C.Ravi	10.000	16.9
5.	1989	World Watch Paper No.3	20.000	28.9
6.	1990	Ministry of Agriculture	8.526	12.3

Table 1.2 Extent of Water logged area as estimated by various agencies

Sl. No.	State	As per National Commission for Irrigation (1972)	As per National Commission on Agriculture (1976)	As estimated by Min. of Agriculture (1990)
1.	Andhra Pradesh	N.R.	3.39	3.39
2.	Assam	N.R.	N.R.	4.50
3.	Bihar	N.R.	1.17	7.07
4.	Gujarat	N.R.	4.84	4.84
5.	Haryana	6.5	6.20	6.20
6.	Jammu & Kashmir	N.R.	0.10	0.10
7.	Karnataka	0.07	0.10	0.10
8.	Kerala	N.R.	0.61	0.61
9.	Madhya Pradesh	0.57	0.57	0.57
10.	Maharashtra	0.28	1.11	1.11
11.	Orissa	N.R.	0.60	0.60
12.	Punjab	10.90	10.90	10.90
13.	Rajasthan	3.48	3.48	3.48
14.	Tamil Nadu	N.R.	0.18	0.18
15.	Uttar Pradesh	8.10	8.10	19.80
16.	West Bengal	18.50	18.50	21.80
17.	Delhi	N.R.	0.01	0.01
	Total	48.40	59.86	85.26

upper reach and very mild in the lower reach. The relief map of the state (Fig 1.1) gives a general idea about the topography of the region. On the right bank of the river Ganga there are extensive Tal lands which require effective drainage to raise the productivity. Tal land is a low lying water logged area of about 1062 sq.km. This area is popularly known as Mokama Tal. It comprises of Seven Tals. Break up of the Tal area is shown in Fig 1.2. The Mokama Tal remain water logged for the whole of the monsoon period. This hampers the cultivation of Kharif crop. The area needs timely drainage after the monsoon flooding to ensure efficient cultivation. When the Tal water is drained out timely it leads to bumper Rabi crop. Efforts have been made by various individuals and committees constituted by the Government to identify the major cause of water logging problem in Tal area and its possible solutions. Some schemes, as proposed in different studies, were also executed by the Government to combat this problem.

In the present study an attempt has been made to describe the Tal area, nature and extent of problem, findings/ suggestions of various studies and status of various efforts made so far.

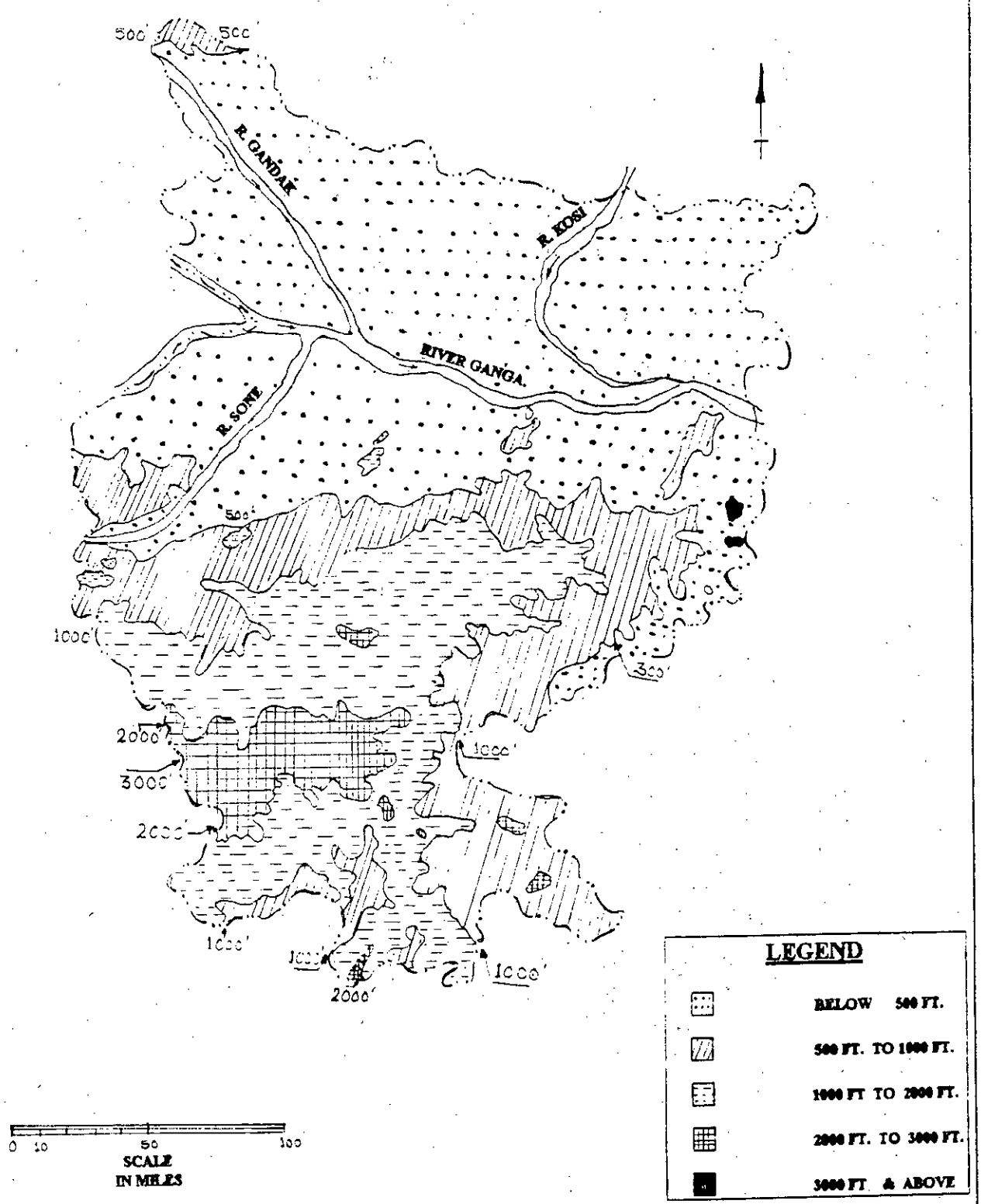

FIG. 1.1: RELIEF MAP OF BIHAR

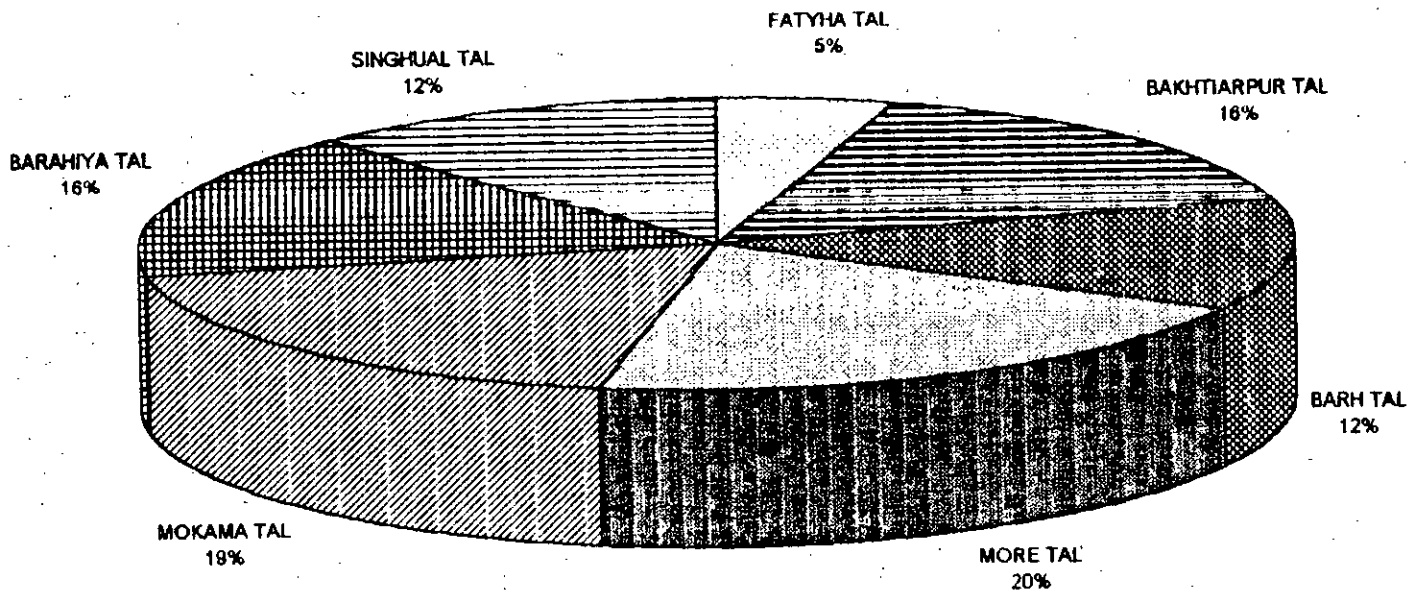

FIG. 1.2 BREAK UP OF THE AREA IN DIFFERENT TALS

2.0 PHYSICAL DESCRIPTION OF THE STUDY AREA

2.1 Topography and Physical Features

The study area popularly known as Mokama Tal is an area of fertile and low lying land on the right bank of the river Ganga and south of eastern railway line running parallel in a length of 104.6 km and width varying from 6.4 km to 17.7 km. The area remains water logged for the whole of the monsoon period. It has been divided into several subareas by south north embankments, rails, roads or other natural divides. The land between the railway line and Ganga is rather high and consequently natural drainage across this land is not possible. On the south of the Tal area, the terrain is very flat. The tragedy of the area is its topography which renders drainage difficult for the area.

2.2 River System

Various rivers that rise from South Bihar and flow in northward direction enter the Tal from the south and form one channel named Dhowa and later Harohar, flowing from west to east in the middle of the Tal (Fig.2.1). The Tal area acts as a delta for right bank tributaries of river Ganga in between Mohane and Nata valleys. Lilajan and Mohane rivers rise from the hills of

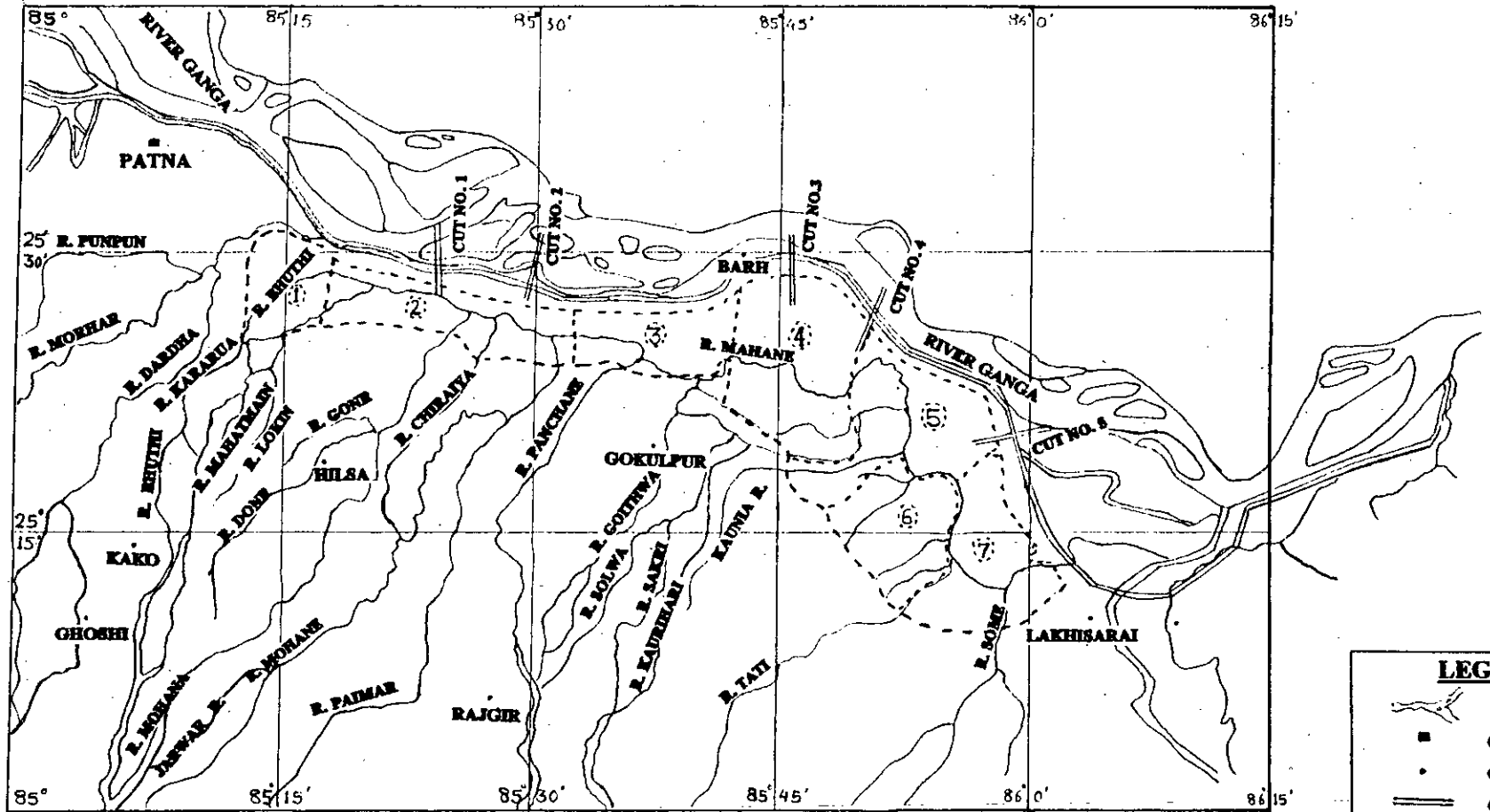

FIG. 2.1: INDEX MAP OF MOKAMA GROUP OF TAL

Hazaribagh district which is in the south west corner of the basin. The river Mohane rises at an altitude of 915 m above M.S.L. At a distance of about 12 kms south of Gaya these two rivers join together and known as Falgu. The river Falgu again bifurcates into Mohane and Falgu after traversing a distance of about 40 kms. The river Falgu further splits into two channels namely main Falgu channel and Lokain channel. The main Falgu channel has a new name Dhowa when it enters into Fatuha Tal. This river than turns east and flows parallel to the Ganga. The Lokain channel meets Dhowa near Khusrupur. The river Mohane also bifurcates into two channels. The western channel of bifurcated Mohane river has the original name of Mohane. It meets Dhowa near Bakhtiarpur. The combined channel thereafter is also called Mohane which, in later reach, is known as Harohar. All the rivers of Mohane, Panchane, Sakri and Nata valleys flowing usually from south to north enter the Tal at different points. The main central river flowing through the Tal area from west to east is called by several names such as Dhowa, Mohane and Harohar in different sections of the Tal area. Finally the river Harohar, which is the main outlet channel for the entire Tal area, flows eastward for 25 kms after crossing Railway line and P.W.D. road and drains into the river Kiul near Rahuaghat. From this

confluence the combined Kiul-Harohar flows in the north east direction and ultimately falls in the river Ganga near Surajgarh. The Tal and all these rivers lies in Kiul-Harchar basin. The total drainage area of the river Harohar above its confluence with river Kiul which directly feed these Tals is about 13,340 sq.km. Out of this the drainage area of few rivers is given in the table (Table 2.1) below:

Table 2.1. **Catchment area of some of the rivers contributing to Mokama group of Tals**

Sl. No.	Name of River	Catchment Area in sq. kms.
1.	Tilaiya	181.00
2.	Dhadhar	240.00
3.	Lilagan	646.00
4.	Mohane	990.00
5.	Job	42.50
6.	Morhar	256.00

2.3 Mokama Group of Tals

Mokama group of Tals extends over Fatuha, Bakhtiarpur, Barh, Pandarak and Mokama blocks of Patna district, Harnaut and Sarmera of Nalanda district, and Barahiya and Lakhisarai of Munger district. It has a total area of about 1062 Sq Km., lying

between latitude 25° 10'N to 25° 35'N and longitude 85° 5'E to 86° 8'E. Mokama Tal lies in Kiul-Harohar river basin and having a saucer shaped depression extending from Fatuha in the west to Lakhisarai in the east. The length of the depression is about 100 Km and its width varies from 6 Km to 17 Km. It spreads over an area of about 1062 Sq Km, running close and almost parallel to the right bank of river Ganga, from Fatuha to Lakhisarai. Drainage slope of the Tal area is mainly from west to east. The area has got cross slope also from south to north up to Harohar. The strip of Tal cross-drains from north to south on the north of the Harohar. The topography of the area clearly indicates that the river Harohar is the master drain of the Tals(**Fig 2.1**).

Though the Mokama group of Tals is continuous from Fatuha to Lakhisarai, it is differently named in its different reaches. These are namely Fatuha Tal, Bakhtiarpur Tal, Barh Tal, More Tal, Mokama Tal Barahiya Tal and Singhaul Tal.

2.3.1 Area and Capacity of Tals

The area, capacity, ground elevation and range of highest water level of Tals are presented in **table 2.2.** The Mokama Tal spreads over a very large area of about 200 Sq Km, while Fatuha Tal has a total area of about 52 Sq Km. The total

combined capacity of the various Tals at HFL is approximately 4.37 Lham. It varies from RL 50.80 m in Fatuha Tal to RL 43.10 m in Barahiya Tal. From west to east the differences in the lowest and highest ground levels are 8.54 m and 7.63 m respectively. The difference in highest water level is 7.70 m. This indicates that water surface in Tal is nearly parallel to the land surface.

Table 2.2. Area, ground elevation and highest water level of the Tals

Sl. No.	Name of Tal	Capacity at HFL in ham	Area in Sq Km.	Ground Elevation in m	Highest water level 1971-91 in m
1	Fatuha Tal	5,562	52.00	46.94 to 47.25	50.80
2	Bakhtiarpur Tal	7,968	168.00	43.58 to 47.24	48.67
3.	Barh Tal	22,030	132.00	42.06 to 46.02	47.30
4.	More Tal	85,777	215.00	39.32 to 44.20	45.07
5.	Mokama Tal	1,04,994	200.00	38.40 to 41.75	44.15
6.	Barahiya Tal	1,12,025	171.00	38.70 to 41.65	43.10
7.	Singhaul Tal	97,495	124.00	38.40 to 39.62	43.10
	Total	4,36,851 ≃ 4,37 Lham	1062.00		

2.3.2 River System of Tals

Line diagram of various rivers joining the Tal area is shown in Fig.2.2. River system for each Tal is described below:

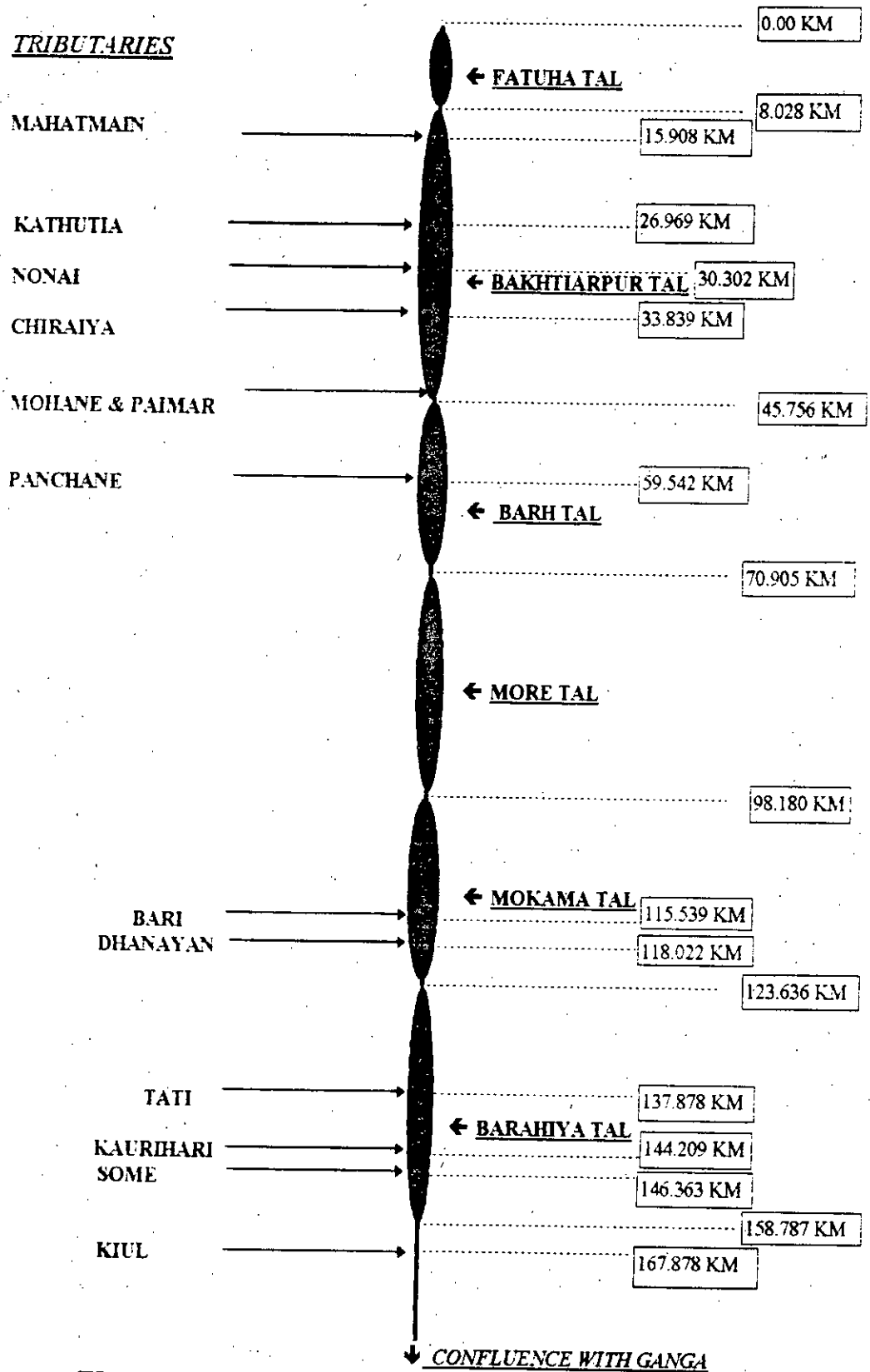

FIG. 2.2 LINE DIAGRAM OF RIVERS JOINING THE TAL AREA

2.3.2.1 Fatuha Tal

The Fatuha Tal is in the eastern most part of Tal area and is smallest in area. River Dhowa, an important branch of river Falgu flowing in serpentine course enters the Fatuha Tal area and flowing centrally in north east direction makes an exit through a railway culvert 4.8 km south of the Fatuha railway station on the Fatuha-Islampur railway embankment and enters the Bakhtiarpur Tal. River Mahatmain, another branch of river Falgu, enters the Fatuha Tal, travels some distance and enters the Bakhtiarpur Tal through another railway culvert.

2.3.2.2 Bakhtiarpur Tal

River Mahatmain flowing down joins river Dhowa which flows eastwards almost centrally of Bakhtiarpur Tal. A spill channel Kathautia, taking off from river Mahatmain and flowing almost parallel to Dhowa is joined by another branch of river Falgu and finally meets the river Dhowa at Landih. Dhowa flowing down from here to eastward is joined by two other branches of river Falgu namely river Nonai and river Chiraiya coming from south. It finally meets river Mohane combined with river Paimar at the end of the Bakhtiarpur Tal (just before entry in the Tal). Now the combined river Dhowa as river Mohane after their

confluence, makes an exit from the Bakhtiarpur Tal through a culvert and enters Barh Tal. The Bakhtiarpur Tal is bounded west-east and north by railway embankments.

2.3.2.3 Barh Tal

River Mohane passing through a railway culvert brings water from Bakhtiarpur Tal and travels eastward. River Panchane meets river Mohane flowing from the south in the Tal. The river Mohane crosses the Barh Tal and enters More Tal. Barh Tal is bounded by railway embankment on the west and north and by road embankment on the east.

2.3.2.4 More Tal

River Mohane flowing in serpentine course in the southern half part of More Tal crosses this Tal and enters Mokamah Tal. More Tal is bounded by a road on the west, railway embankment on the north and the left bank of the river Bari in the south.

2.3.2.5 Mokamah Tal

River Mohane carrying water from More Tal enter into Mokama Tal from northern boundary and travels almost southward. Then it is joined by river Bari and further down by river Dhanayan. It flows downward and known as river Harohar which

enters the Barahiya Tal. Mokamah Tal is bounded on the north by the railway embankment and most of its southern boundary by a road.

2.3.2.6 Singhaul Tal

The central river flowing in Mokama Tal and Barahiya Tal makes northern and eastern boundary of Singhaul Tal. Some small tributaries of river Harohar enter this Tal from the south. River Tati flows through the south eastern part of the Tal and joins river Harohar in the Barahiya Tal. Most of the northern boundary of Singhual Tal is formed by the course of the river Harohar while road embankment bound part of the Tal on the west as well as east.

2.3.2.7 Barahiya Tal

River Harohar, entering from Mokamah Tal, traverse long the western boundary of Barahiya Tal. The river Tati, originating near Morui, east of Sakri valley, traverses a distance of about 50 kms and meets the river Harohar in Barahaiya Tal area. After meeting with river Tati, its course turns eastward. Two more rivers Kaurihari and Some entering the Tal from the south meet river Harohar at two different points. Harohar, which is the outlet channel from the entire Tal area,

flows eastward more than 16 kms after exit from the Tal boundary and is joined by river Kiul from the south. From this confluence it continues to flow in the north eastern direction towards its ultimate destination of the confluence with river Ganga about 16 km downstream. The western side of Barahiya Tal forms the boundary of Mokamah Tal in the north and Singhual Tal in the South. Eastern boundary of this Tal is formed by the embankment of eastern railway southern boundary by road embankment.

2.4 Geology and Soils

The Tal area is a saucer shaped shallow depression and it has semi undulation with micro-relief. The maximum and minimum height of the Fatuha-Mokama-Barahiya Tal area varies from 36 m to 45 m from east to west above MSL and northerly slope is moderate. The slope of the Tal varies from 0.057 m/km to 0.095 m/km from west to east. The underlying soil for Tal area is impervious clay and silt having low moisture yielding capacity. The core of the Tal area has a surface cover of dense, poorly drained, unoxidised and humus rich clayey soil. It is grading into progressively lighter soil towards peripheral part with progressive increase in silt fraction. The sub-surface characteristics of the Tal area give an indication that nearly 50 per cent of the area underlain by an over-lapping alternation of grey, to dark grey semi-sticky

to sticky clay and silt with lenticular layers of fine sand at places. While approaching towards the levee area lateral faces variation from clay to silt and to silty clay is common. The Tal area is essentially built up by the major contribution from the upland drainage system originating from South Chotanagpur highland which transported silty or fine sand into this backswamp. Sediment brought by flood water for the spill over water of the Ganga has also contributed to it. The neo-tectonic movement along the Giriyak-Sheikhpura and the Sone linoaments explains the formation of the upland drainage system.

Geomorphologically, the entire Tal area is divided into three substratas: alluvial uplands; older flood plain and; present flood plain of the Ganga on the northern side of Patna-Mokama road and the Ganga. The Alluvial land-form units of the Tal area include: the natural levee running east-west along the down stream of Ganga; backswamp and; aggraded channels draining down into backswamp

There are three physiographic zones in the Kiul-Harohar basin which govern the cropping sequence widely. The southern part of the basin has old alluvium grey to greyish yellow soils with heavy texture. The middle zone comprises the famous Tal

lands which remain under water for two and four months during Kharif but are intensively cropped during rabi. The extreme northern part of the basin consists of alluvial zone up to the river Ganga.

2.5 Land use

The area under forest in the Kiul-Harohar river system is about 7 percent while the cropped area is 50 percent of the total area. The area under irrigation is about 50 percent of the cropped area.

In the Tal area land use practices of different land form units have different land use practices. These are presented in table 2.3.

Table 2.3. Land use practices in Tal area

Sl.No.	Land Form Unit	Land Use Practice
1.	Natural levee	Multiple or double cropping mainly *Wheat* during Kharif and *Gram* during Rabi season
2.	Backswamps	Single cropping mainly *Gram* and *Mustered oil* seeds

2.5.1 Cropping Pattern in the Tal Area

The geographical area of the Mokama group of Tals is 1062 sq. kms. Out of this area, an approximate estimate of high

land, Rabi land and paddy and double crop area is given in table 2.4. It is clear from table 2.4 that about three-fourth of the total Tal area is Rabi land and only 16.76% area is paddy and double crop land, whereas in other part of Patna and Munger districts, Kharif intensity is much more than Rabi.

Table 2.4. Broad Land Classification in Tal Area

Sl. No.	Name of Tal	Area in sq. km.			Total Area in sq.km.	% of Total Area of Tals
		High Land	Rabi Land	Paddy & Double crop Area		
1.	Fatuha Tal	5.12	32.80	14.08	52	4.88
2.	Bakhtiarpur Tal	23.04	91.20	53.76	168	15.85
3.	Barh Tal	15.36	93.60	23.04	132	12.44
4.	More Tal	23.04	145.88	46.08	215	20.24
5.	Mokama Tal	7.68	161.60	30.72	200	18.79
6.	Barahaiya Tal	17.92	153.08	-	171	11.70
7.	Singhaul Tal	-	113.76	10.24	124	16.10
	Total	92.16 (8.66%)	791.92 (74.58%)	177.92 (16.76%)	1062	100.00

Various crops presently grown in the Tal area are broadly classified under Kharif, Rabi and Hot weather. The main crops grown in the area are pulses, oilseeds and wheat. Paddy and Maiz are grown in the fringe areas of Tals. Cropping patterns in Fatuha Tal, Bakhtiarpur Tal, Barh Tal, More Tal, Mokama Tal and Barahiya Tal from year 1977 to 1991 are presented in Figures 2.3 to Figure 2.8. For Singhaul Tal cropping pattern from 1978 to

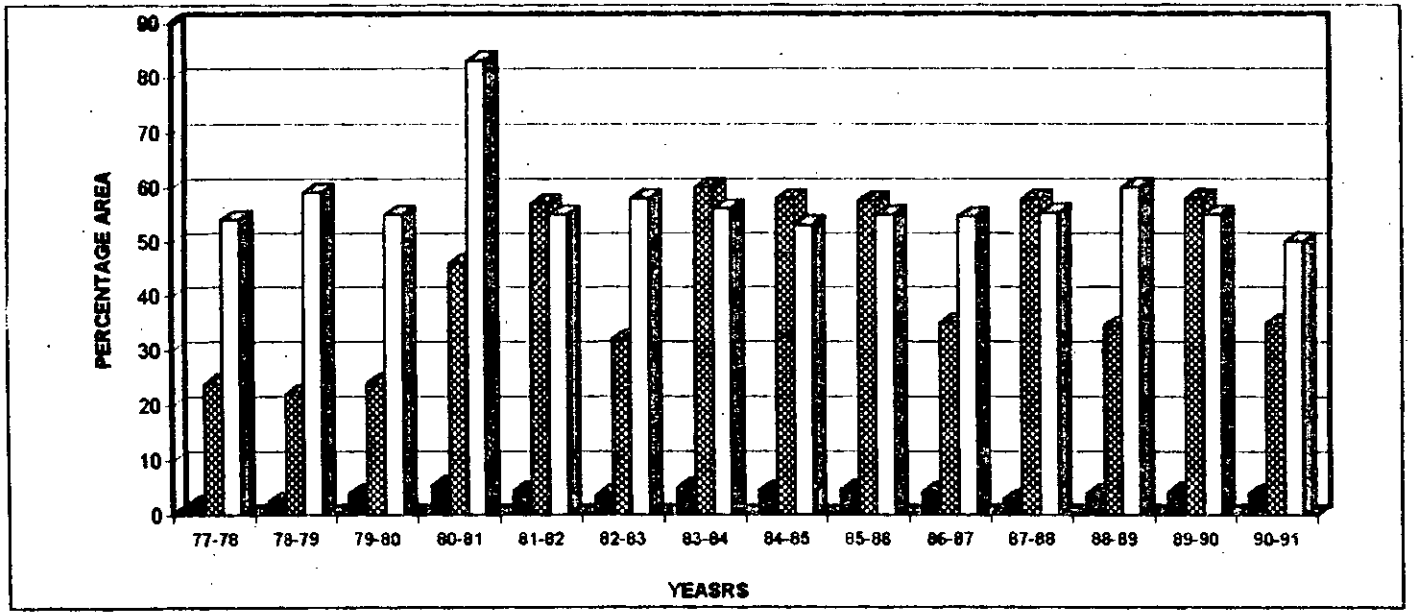

FIG. 2.3 : PERCENTAGE AREA UNDER CULTIVATION IN FATUHA TAL

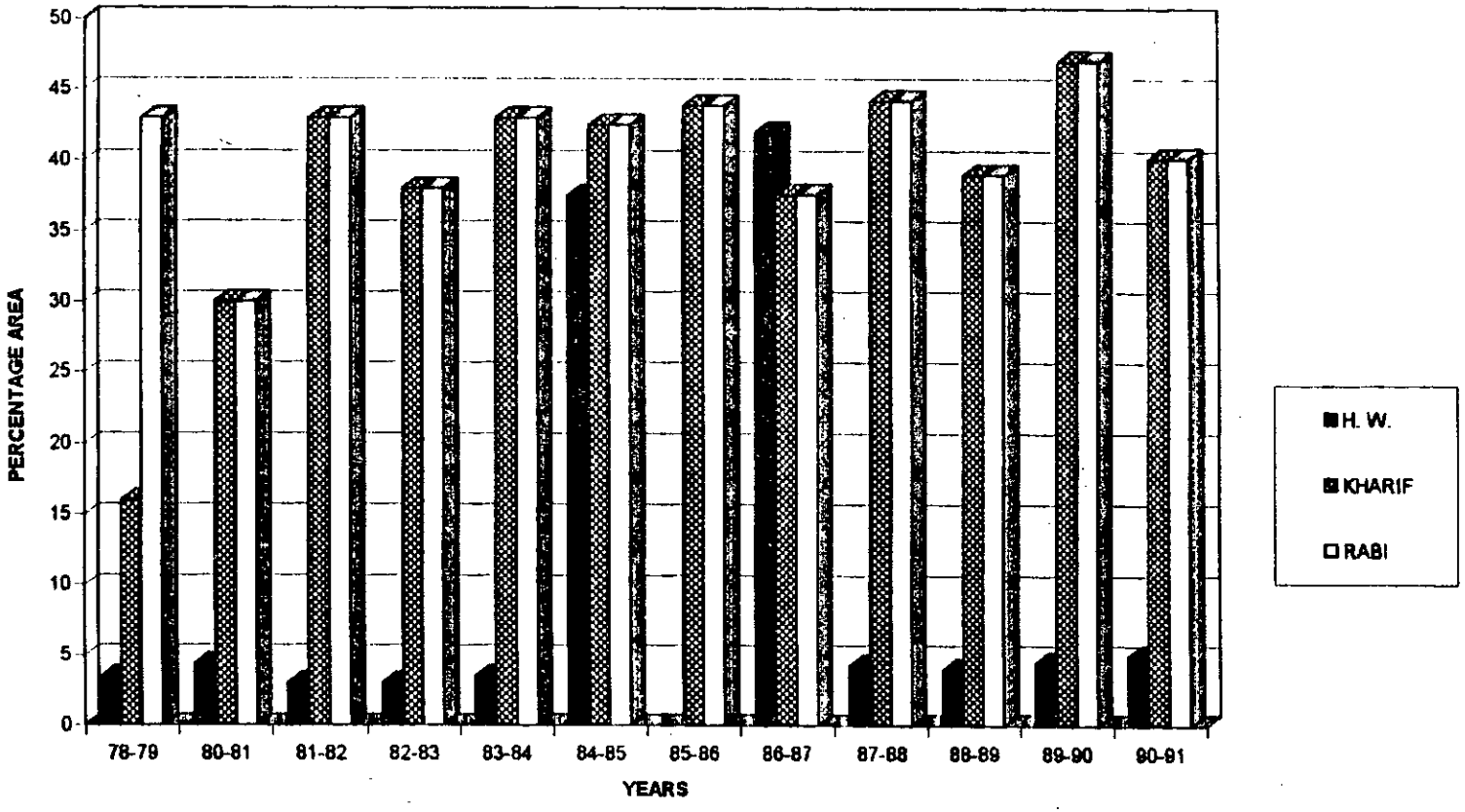

FIG. 2.4 : PERCENTAGE AREA UNDER CULTIVATION IN BAKHITARPUR TAL

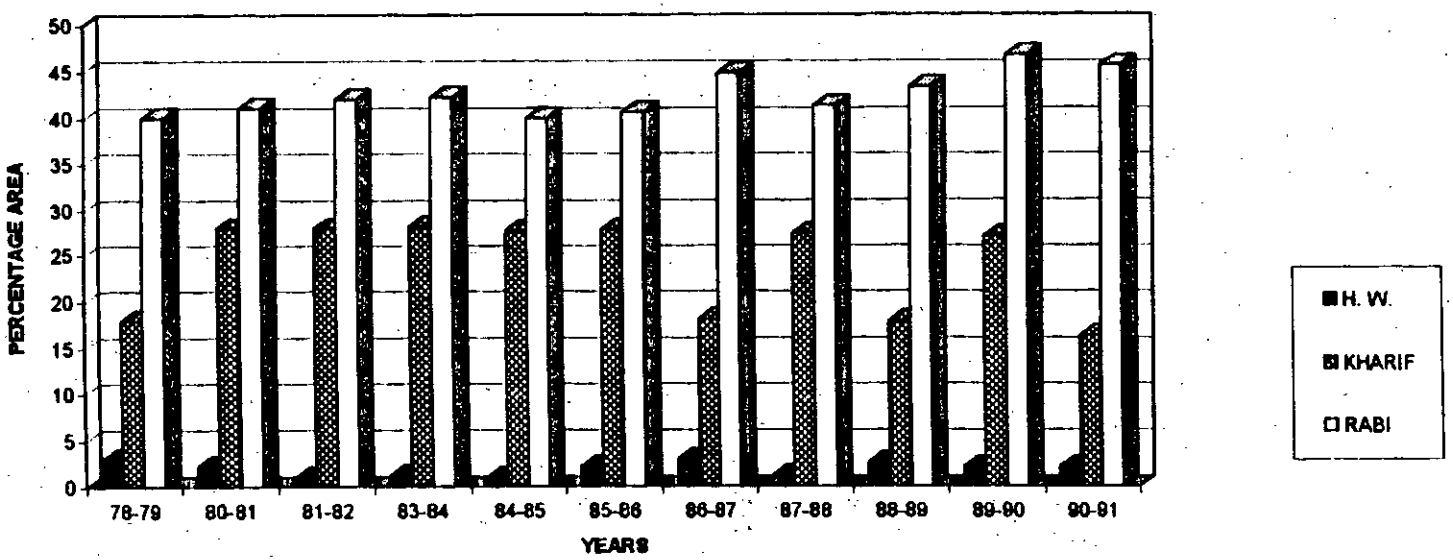

FIG. 2.5 : PERCENTAGE AREA UNDER CULTIVATION IN BARH TAL

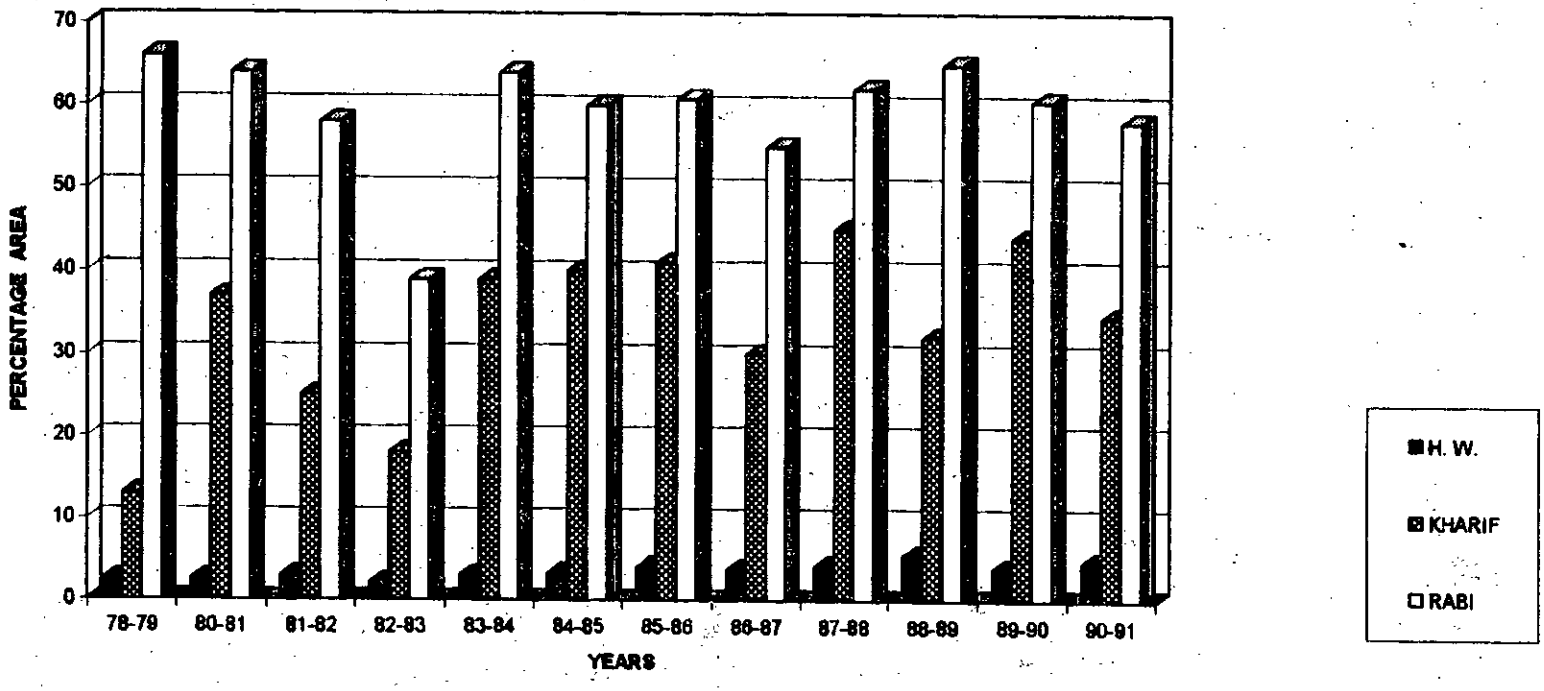

FIG.2.6 : AREA UNDER IRRIGATION IN MORE TAL

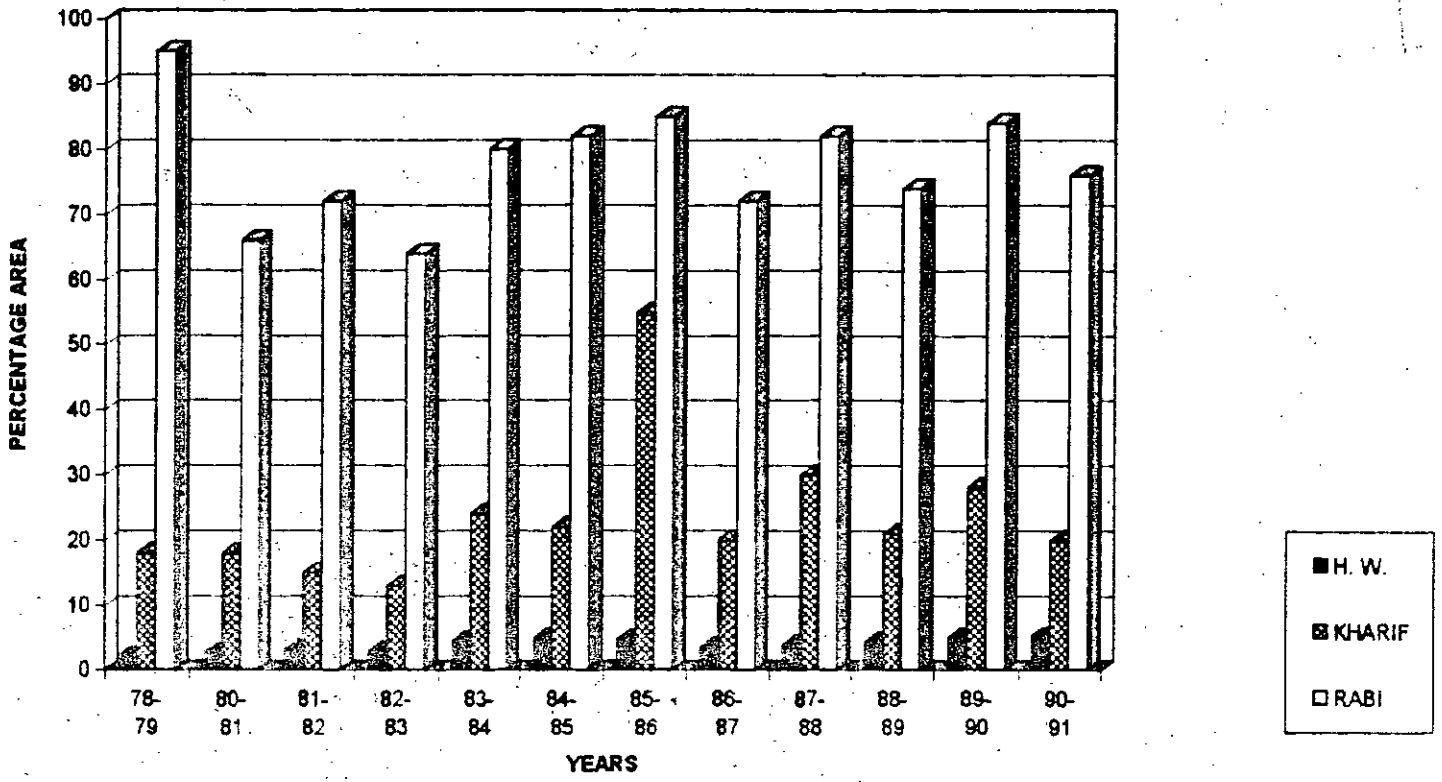

FIG. 2.7 : PERCENTAGE AREA UNDER IRRIGATION IN MOKAMA TAL

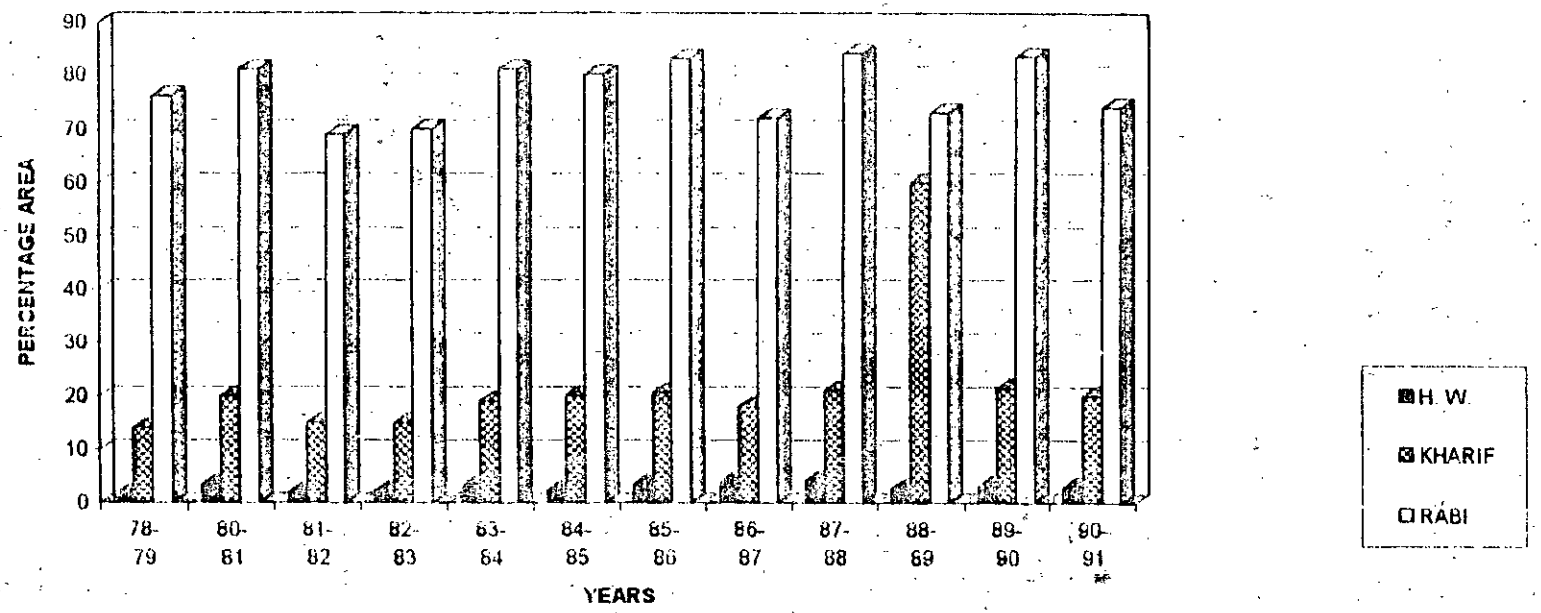

FIG. 2.8 : PERCENTAGE AREA UNDER IRRIGATION IN BARAHIYA TAL

1983 is presented in Figure 2.9. Table 2.5 shows the variation in cropping pattern in various Tals. Average percentages of Kharif, Rabi and Hot Weather crops are given in Table 2.6.

Table 2.5. Variation in cropping pattern in various Tals

Sl. No.	Name of Tal	Year	Percentage variation in		
			Kharif	Rabi	Hot Weather
1.	Fatuha Tal	1977-91	22.00-60.00	50.00-83.00	1.92-5.44
2.	Bakhtiarpur Tal	1977-91	16.00-47.00	43.00-74.00	3.00-42.0
3.	Barh Tal	1977-91	17.91-28.17	39.92-46.70	1.00-3.02
4.	More Tal	1977-91	13.00-45.00	39.00-66.00	2.13-5.40
5.	Mokama Tal	1977-91	13.00-55.00	64.00-95.00	2.13-5.20
6.	Barahiya Tal	1977-91	14.00-60.00	70.00-84.00	1.68-4.30
7.	Singhaul Tal	1977-83	21.00-51.00	62.00-87.00	1.88-3.69

Table 2.6. Average cropping intensity in various Tals

Sl. No.	Name of Tal	Area in sq.km.	Average % of Kharif, Rabi and Hot Weather crops		
			Kharif	Rabi	Hot Weather
1.	Fatuha Tal	52	42.91	57.35	4.04
2.	Bakhtiarpur Tal	168	38.52	61.06	9.51
3.	Barh Tal	132	24.31	42.49	1.89
4.	More Tal	215	33.21	59.36	3.49
5.	Mokama Tal	200	23.67	77.66	3.95
6.	Barahiya Tal	171	22.00	77.21	3.05
7.	Singhaul Tal	124	37.50	74.67	2.45
	Total	1062 Average	30.30	65.54	4.16

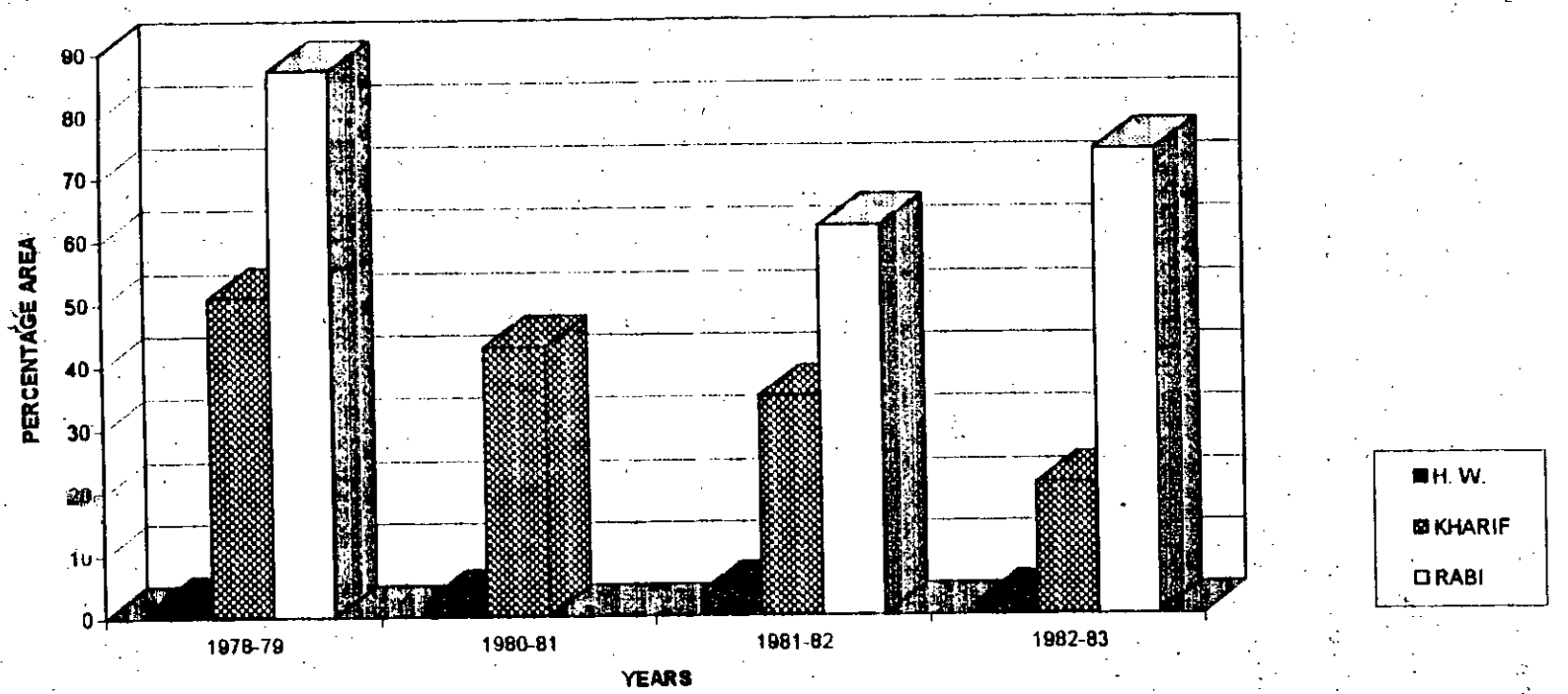

FIG. 2.9 : PERCENTAGE AREA UNDER IRRIGATION IN SINGHAUL TAL

2.5.2 Irrigation Facilities in the Tal Area

The Tal area is irrigated by a number of tubewells both State and private, irrigation wells and river pumping set. The state tubewells have 12" open boring. While the private tubewells have 4" open boring. Irrigation capacity of state and private tubewells are 200 acre/tubewell and 2.5 acre/tubewell respectively. The figure of existing state and private tubewells is given in **Table 2.7** and **Table 2.8**. Total number of existing river pumping set and irrigation wells in the Tal area (as given in the report Mokama Tal Technical Cum-Development committee) is presented in **Table 2.9**.

Table 2.7 Irrigation Capacity of State Tubewells

Sl. No.	Name of Tal	No. of State Tubewells	No. of Tubewells not under Operation	No. of Tubewells under Operation	Total Irrigation Capacity in Acre
1.	Fatuha Tal	29	19	10	2000
2.	Bakhtiarpur Tal	36	24	12	2400
3.	Barh Tal	42	25	17	3400
4.	More Tal	32	24	8	1600
5.	Mokama Tal	28	20	8	1600
6.	Barahiya Tal	43	36	7	1400
7.	Singhaul Tal	21	14	7	1400
	Total	231	162	69	13800

Table 2.8 Irrigation Capacity of Private Tubewells

Sl. No.	Name of Tal	No. of State Tubewells	No. of Tubewells not under Operation	No. of Tubewells under Operation	Total Irrigation Capacity in Acre
1.	Fatuha Tal	567	0	567	1417
2.	Bakhtiarpur Tal	477	0	477	1192
3.	Barh Tal	814	22	792	1980
4.	More Tal	80	0	80	200
5.	Mokama Tal	2050	0	2050	5125
6.	Barahiya Tal	3238	0	3238	8095
7.	Singhaul Tal	402	0	402	1065
	Total	8348	22	7206	19074

Table 2.9 Irrigation wells and river pumping sets in Tal area

Sl. No	Name of Tal	River Pumping Set	Other sources like wells etc.
1.	Fatuha Tal	-	609
2.	Bakhtiarpur Tal	-	-
3.	Barh Tal	-	-
4.	More Tal	426	-
5.	Mokama Tal	298	-
6.	Barahiya Tal	12	-
7.	Singhaul Tal	4	-
	Total	740	609

2.6 Ground Water

The static water level in the area varies from 3.25 m to 5.60 m. In the Tal area potentiality of sub-surface water is moderate to moderately high. Depth of 60 m to 90 m and 0.3 diameter deep tubewells are feasible in the area. Tubewells can

yield sub-surface water at the rate of 1,60,000 litre/hr to 2,00,000 litre/hr.

2.7 Hydrology of the Tal Area

About 85 percent of the annual rainfall occurs during the monsoon months from June to September. In the Tal area average rainfall value is about 101 cm while that in the upper zone of the basin i.e. in the hills of Hazaribagh district is about 125.7 cm approximately. Eighty fife per cent of the total rainfall occur during the monsoon months, i.e. from June to September. The total runoff, from the catchment areas of the river entering the Mokama group of Tals, has been worked out on the basis of sixteen year rainfall data of 65 blocks falling in the Kiul-Harohar basin from the year 1974 to 1989 (Second Bihar State Irrigation Commission, 1994). The maximum and minimum monsoon rainfall in the basin during the period from 1974 to 1989, has been recorded as 1541.7 mm and 783.3 mm in the year 1987 and 1982 yielding total surface monsoon runoff from the catchment as 10.57 Lham and 2.88 Lham respectively.

2.7.1 Rainfall pattern

Mokama group of Tals lying in part of Patna, Nalanda and Munger district. Monthly values of average annual rainfall (1980-1985) of these districts are presented in **Table 2.10**. It is

seen from the table that about 85% of total annual rainfall occur in just four months from June to September. The Tal area is very much prone to flood. Frequency of flood in various blocks is given in Table 2.11.

Table 2.10. Average normal rainfall (in cm) in Tal area 1980-85.

District	Jan	Feb	Mar	Apr	May	June	July	Aug.	Sep.	Oct	Nov	Dec
Patna	14.7	20.0	7.0	7.0	23.0	117.2	251.9	296.2	198.3	46.6	8.4	3.5
Nalanda	13.7	19.3	8.4	9.0	21.0	120.9	266.8	287.4	185.1	41.5	11.1	3.5
Munger	14.8	22.0	12.3	15.6	48.1	181.2	295.5	312.7	218.4	72.3	10.3	3.5

Table 2.11. Frequency of flood prone areas

Sl. No.	Block	Years of Flood	Frequency during 1970 to 1986
1.	Fatuha	1971,73,76,78,80,82,84,85,86	9
2.	Bakhtiarpur	1971,73,74,75,76,78,80,82,83,86	10
3.	Barh	1971,73,74,75,76,78,80,82,83,85,86	11
4.	Pandarak	1971,73,74,75,76,78,80,82,84,86	10
5.	Mokama	1971,73,74,75,76,78,80,82,84,85,86	11
6.	Harnaut	1971,73,76,78,80,81,84,86	8
7.	Sarmera	1971,73,76,78,80,81,84,86	8
8.	Barahiya	1971,73,75,76,78,80,82,83,84	9
9.	Lakhisarai	1971,73,75,76,78,80,82,83,84,85	10

2.7.2 Stream flow

The maximum observed discharge at different gauge sites in the Kiul-Harohar river system is given in Table 2.12.

Table 2.12. Maximum observed discharge of the Kiul-Harohar river system

Sl. No.	River	Gauge Site	Maximum observed discharge in M^3/Sec	Year
1.	Kiul	Lakhisarai	1722.93	1962
2.	Harohar	Mankatha	1840.00	1971
3.	Sakari	Kaderganj	1998.30	1965
4.	Falgu	Gaya	2488.13	1976

2.7.3 Inflow into Tal area

Yearly inflow from the Kiul-Harohar basin has been calculated on the basis of rainfall data of 65 blocks falling in the catchment and tabulated in Table 2.13 (Report of the second irrigation commission, 1972). A time series plot of the rainfall-runoff (Figure 2.10) and maximum capacity(4.37Lham) of Tal indicates that the total monsoon runoff is generally equal to or more than the capacity of Tals. When considering the upstream utilisation of monsoon runoff in the tune of 1.04' Lham for irrigation purpose the balance inflow (Table 2.13) is worked out.

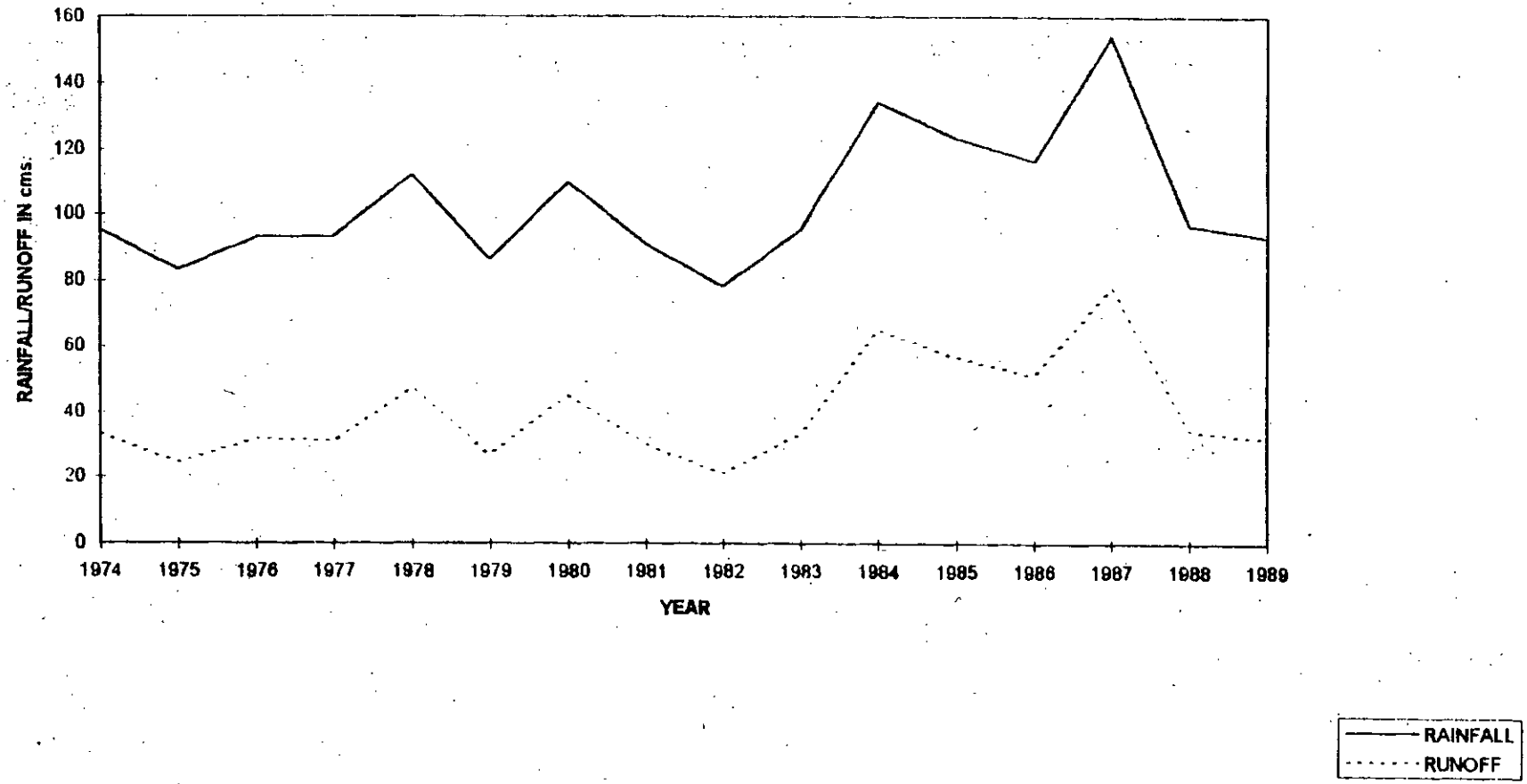

FIG. 2.10: TIME SERIES PLOT OF RAINFALL- RUNOFF

Table 2.13. Rainfall-runoff and Inflow data

Year	Monsoon Rainfall in cm	Runoff in cm	Runoff in Lham	% Tal filled up with total monsoon runoff	Inflow entering the Tal (after deducting 1.04 Lham from monsoon runoff) in Lham	% Tal filled up with inflow
1974	95.47	33.25	4.49	100	3.45	79
1975	83.29	24.46	3.30	75	2.26	52
1976	93.12	31.42	4.24	97	3.20	73
1977	93.30	30.81	4.16	95	3.12	71
1978	111.94	47.09	4.36	100	3.32	76
1979	86.41	26.67	3.60	82	2.56	59
1980	109.66	45.06	6.08	100	5.04	100
1981	90.94	29.82	4.03	92	2.99	68
1982	78.33	21.34	2.88	66	1.84	42
1983	95.38	33.17	4.48	100	3.44	79
1984	133.99	65.02	8.76	100	7.72	100
1985	123.44	56.69	7.66	100	6.62	100
1986	116.40	51.33	6.93	100	5.89	100
1987	154.17	78.28	10.57	100	9.53	100
1988	96.86	34.34	4.64	100	3.60	82
1989	93.47	31.67	4.28	100	3.24	74

2.8 Agroclimatic Classification

The state is divided into four agroclimatic zones: north-west alluvial plain zone; east alluvial plain zone; south-west as alluvial plains and; south plateau.

In the north-west alluvial plain zone, nearly one third of the total cultivated area in the district of Darbangha, Sitamarhi, Samastipur, Muzaffarpur and East Champaran remain flooded during Kharif seasons. In the east alluvial plain zone, Saharsa and Kosi area face the problem of floods. Diara land in

this zone constitute the worst flood affected area of the State. In the south-west alluvial plains zone the diara lands in Patna and Bhojpur districts are affected by invasion of flood. Hazaribagh, Giridih, Santhal, Pargana, Dhanbad, Palamu, Ranchi and Singbhum districts are in south plateau.

The Mokama group of Tals lies in east alluvial plains and south-west alluvial plains. Most of the catchment of Tals lies in southern plateau.

2.9 Gauging sites in the area

Both state government and Central Government organisations have Rainfall and gauge/discharge stations at various sites in the Tal area and its catchment.

2.9.1 Raingauge Stations

For measurement of rainfall in the Kiul-Harohar basin both IMD and Water Resources Department, Bihar have set up gauging stations. WRD, Bihar has 17 numbers of raingauge stations. These raingauges are installed at Jamuna, Meghatri, Khunla, Gawan, Bendrew, Bhini Jhilari, Ulai Dam site, Kiajori, Barhchatti, Kailan, Tungan, Chatara, Karmatanar, Ganpur, Bagr more and Katam Sandi.

2.9.2 Gauge-discharge sites

In Kiul-Harohar river system both Central Water

Commission and Water Resources Department have gauge/discharge measuring stations. In **Table 2.14** and **Table 2.15** give the detail about gauge/discharge sites of CWC and WRD, Bihar respectively. Water Resources Department, Bihar has 43 gauge-discharge sites and 23 gauge sites (Water Year Book 1992).

Table 2.14. Gauge, discharge, and water quality observation sites in Kiul-Harohar basin maintained by CWC.

Sl. No.	River	Site	Longitude	Latitude	Catchment Area sq.km.	Type of site		
						G	D	WQ
1.	Harohar	Mankatha	86°4'0''	25°10'33''	14,177	yes	yes	no
2.	Kiul	Lakhisarai	86°6'4''	25°10'33''	2,619	yes	yes	yes
3.	Kiul	Sono	85°20'	25°18'	440	yes	no	no
4.	Kiul	Garhi	85°0'	25°5'	260	yes	no	no
5.	Kiul	Jamui	87°30'	25°14'	1,810	yes	no	no

Table 2.15. Gauge and discharge sites in Kiul-Harohar basin maintained by WRD, Bihar.

Sl.No.	River	Site	Method
1.	Lilajan	Kaithan	FM
2.	Lilajan	Bhuiadih	FM
3.	Lilajan	Weir site	FM
4.	Falgu	Udrasthan	FM
5.	Falgu	Manui	FM
6.	Bhaitamain	Jeevanchak	FM
7.	Mohane	Armedag	FM
8.	Mohane	Bhaluachatti	FM
9.	Mohane	Bardih	FM
10.	Mohane	Islampur	FM
11.	Daha	Ekangalsarai	FM
12.	Paimar	Weir site	FM
13.	Tilaiya	Aamghat	FM
14.	Tilaiya	Jalalpur	FM
15.	Dhanarji	Siur	FM
16.	Dhanarji	Padmaaul(Weir)	FM
17.	Rabri	Rahimpur (Weir)	FM
18.	Rabri	Nawada	FM
19.	Panchane	Giriyak	FM
20.	Tilaiya	Baribali	FM
21.	Goithawa	Weir site	FM
22.	Khuri	Rahimpur	FM
23.	Chiraiya	Gath	GS
24.	Mohane	Chandi	FM
25.	Paimar	Bihar-Barbigha Road	FM
26.	Panchane	Bihar-Barbigha Road	FM
27.	Panchane	Dhamauli	GS
28.	Khunti	Panchane Weir 1&2	FM
29.	Sakari	Khunta	FM
30.	Sakari	Baskoi	FM
31.	Bahuara	Goharnagar	FM
32.	Jirain	Bihar-Barbigha	FM
33.	Sakari	Aangachi	GS
34.	Kumhari	Bihar-Baarbigha	GS
35.	Nata	Nata Weir	FM
36.	Kanahari	Weir site	FM
37.	Tati	Sheikhpura Sarbigha	FM
38.	Banbani	Dam site (Kashoia)	FM

Contd....

Sl.No.	River	Site	Method
39.	Kundghat	Dam site	FM
40.	Kanhari	Sheikhpura-Lakhisari	FM
41.	Saru	Sheikhpura-Kiul	FM
42.	Ulai	Dam site	FM
43.	Harihar	Kari-Hari Harihar Complex	GS
44.	Kiul	Lakhisarai-Munger	FM
45.	Haohar	Barahia-Lakhisarai	FM
46.	Dhoba(Tal)	Fatuha-Daniyawa	GS
47.	Ganga	Khusrupur	GS
48.	Ganga	Bidhipur	GS
49.	Ganga	Bakhtiarpur	GS
50.	Ganga	Pipariya	GS
51.	Ganga	Barh	GS
52.	Ganga	Siunar	GS
53.	Ganga	Mahendrapur	GS
54.	Ganga Tal	Hemeja	GS
55.	Ganga	Hemeja	GS
56.	Harohar	Railway Crossing	GS
57.	Kiul	Sarma	GS
58.	Ganga	Piparia	GS
59.	Kiul	Kiul Harohar Bridge	GS
60.	Harohar	Suryagarha	GS
61.	Harohar	Hevarghat	GS
62.	Ganga-Harohar	Sudarpur	GS
63.	Ganga	Munger	GS
64.	Dhadhar	Lehra	FM
65.	Mohane	Ratukha	FM
66.	Lilajan	Hafua	FM

3.0 WATER LOGGING PROBLEM IN TAL AREA

3.1 Nature and Magnitude of Problem

In general, the flood problem in the Kiul-Harohar river system is limited to the problem of the Mokamah Tal area. In addition to discharge from the streams draining into the Tal, this area also gets spills from the Punpun in the West and the spill from the Ganga which finds its way into the Tal by overtopping the Patna-Monghyr road running parallel to the Ganga at some places and also through some culverts. Flooding is also caused by the entry of backwater of the river Ganga through the river Harohar. The only drainage outlet for the Tal is through the river Harohar-Kiul, which has not got adequate capacity to drain out the total Tal area. Consequently, the land remains submerged practically up to the middle of November.

The upper region of the Kiul-Harohar catchment has steep slope and the flood peaks caused by heavy rains which pass off quickly and accumulates in the lower region where the terrain is flat. Due to the peculiar configuration, the flood water continues to accumulate and vast tract of low lying land is subjected to flooding. The longitudinal section of main channel of Mokama Tal is presented in Fig 3.1. The flooding is more

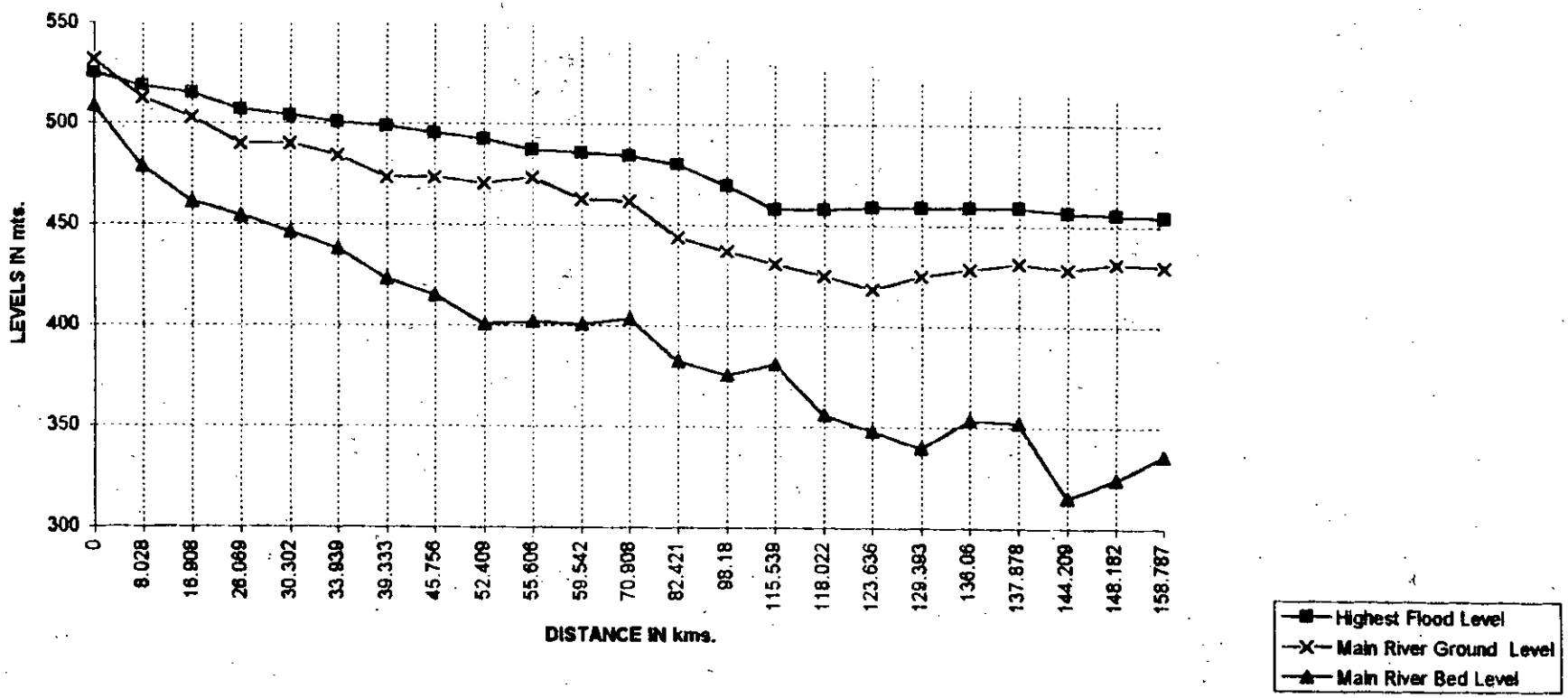

FIG. 3.1 : LONGITUDINAL SECTION OF A MAIN CHANNEL OF MOKAMA TAL

acute particularly when the level in the Ganga remains above danger level for long duration.

There are some internal drainage channels which connect the Mokama group of Tals to the Dhowa and the Harohar rivers. These channels help in draining the Tals but also lead the winter flows into the low pockets and submerge the Rabi crops.

The river Kiul spills over its banks in the lower reaches near Lakhisarai. Flooding was severe in the years 1971, 1976 and 1987. The rivers Sakri and Falgu create problem due to occurrence of flash floods in the rivers. Heavy flood damages were caused in the river system in the year 1976. In recent past, the maximum depth of submergence was recorded in the year 1987 which varied from 3.86 in Fatuha Tal to 5.76 in More and Mokama Tal. Submergence frequency of various Tals from 1972 to 1991 is presented in Figure 3.2 to Figure 3.8. Fatuha Tal, Bakhtiarpur Tal, Barh Tal and More Tal has submergence frequency (Fig 3.2 to Fig 3.5) of above 50% and upto 75% only in 5 to 8 years. Similarly the frequency for the same submergence is very high for Mokama Tal, Barahiya Tal and Singhaul Tal (11,16 and 15 years respectively) as shown in Fig 3.6 to Fig 3.8.

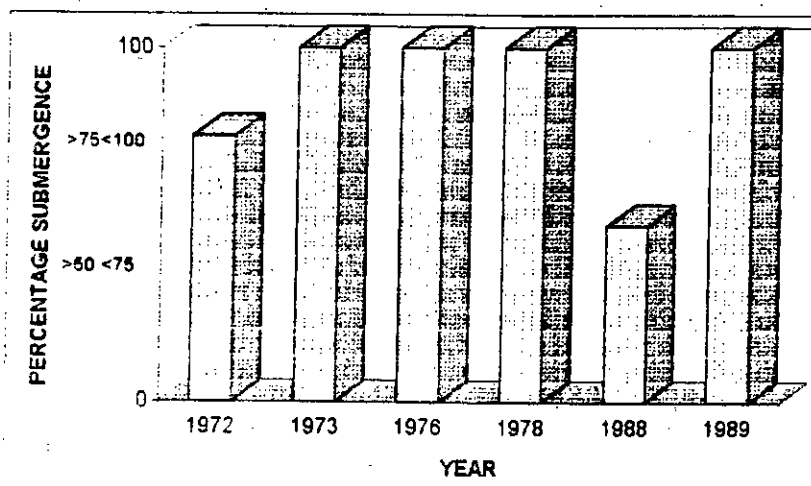

FIG 3.2 : FREQUENCY AND EXTENT OF SUBMERGENCE IN FATUHA TAL

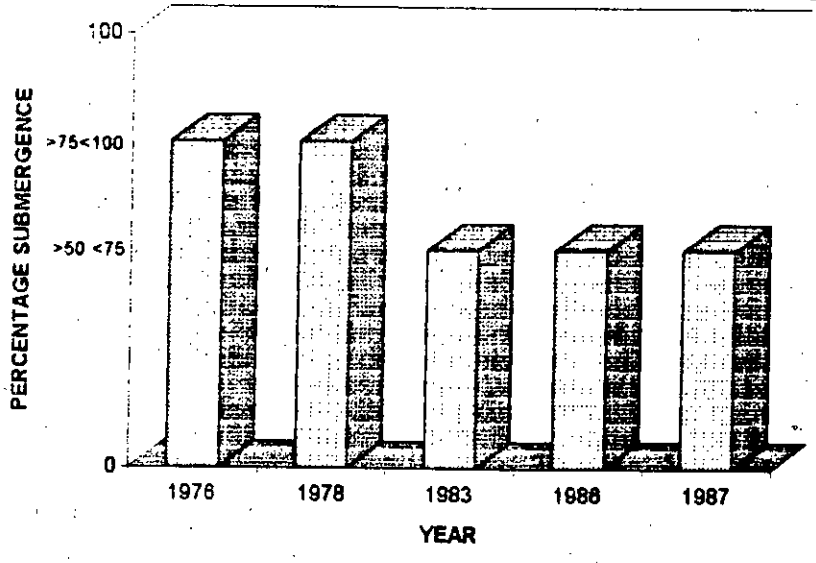

FIG 3.3 : FREQUENCY AND EXTENT OF SUBMERGENCE IN BAKHTIARPUR TAL

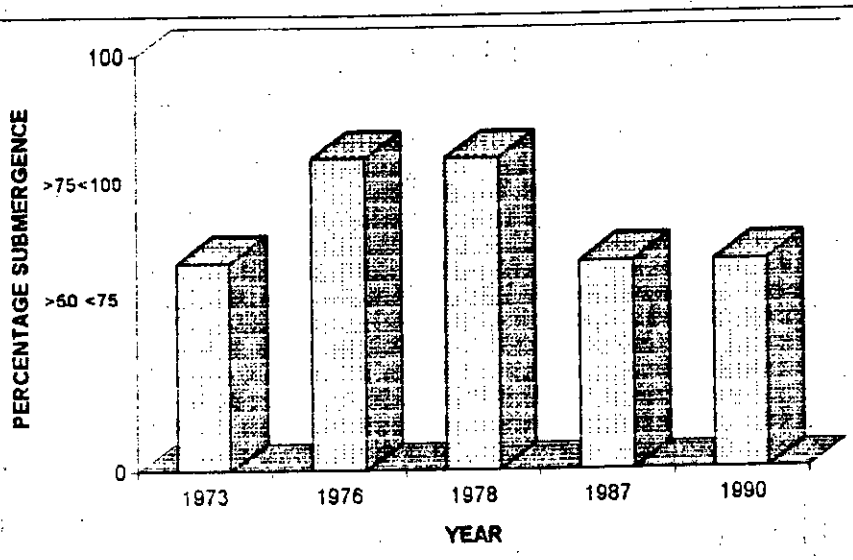

FIG 3.4 : FREQUENCY AND EXTENT OF SUBMERGENCE IN BARH TAL

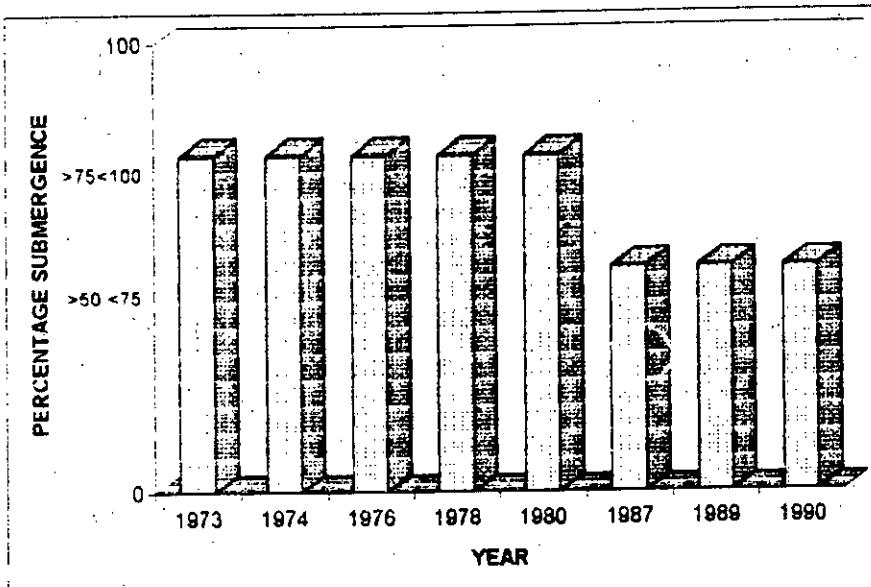

FIG 3.5 : FREQUENCY AND EXTENT OF SUBMERGENCE IN MORE TAL

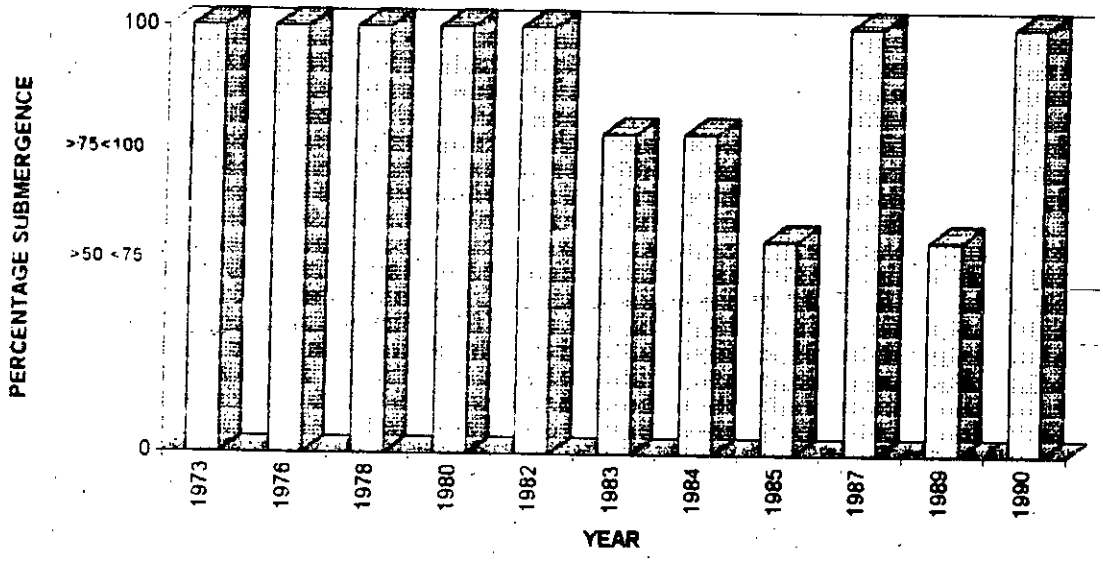

FiG 3.6 : FREQUENCY AND EXTENT OF SUBMERGENCE IN MOKAMA TAL

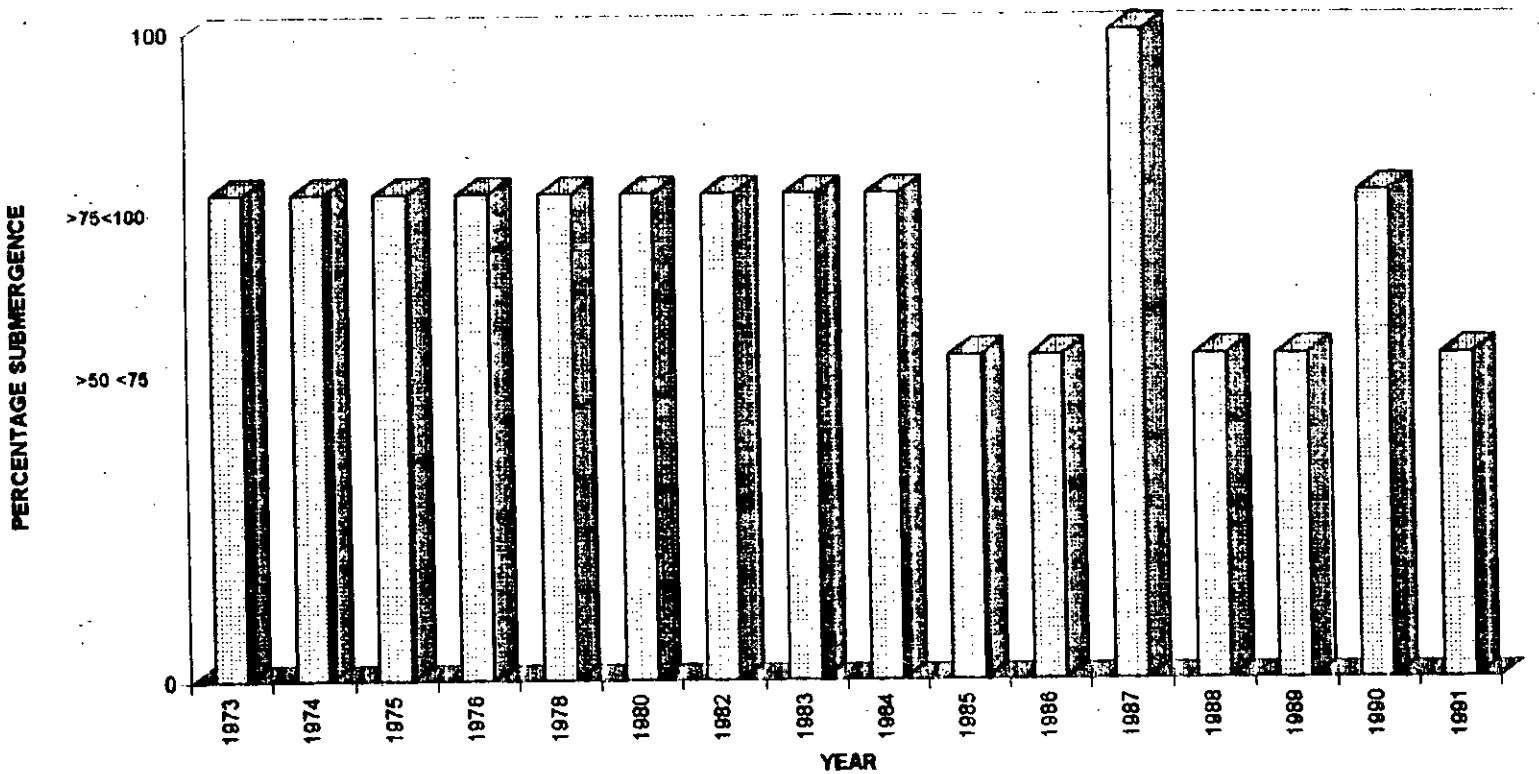

FIG 3.7 : FREQUENCY AND EXTENT OF SUBMERGENCE IN BARAHIYA TAL

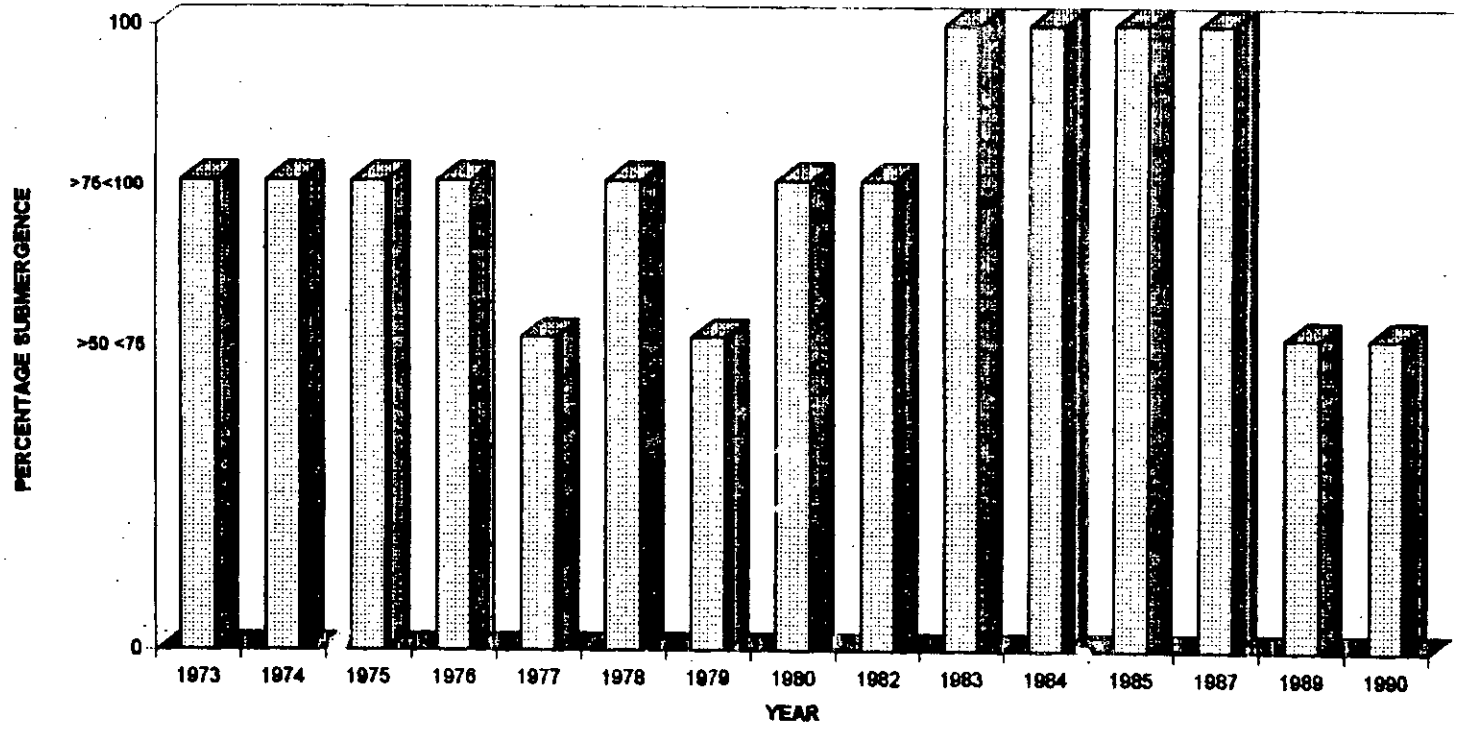

FIG 3.8 : FREQUENCY AND EXTENT OF SUBMERGENCE IN SINGHAUL TAL

3.2 Major Causes of Water Logging in Tal Area

The following are the long felt major causes of water logging in the Tal area.

1. Total catchment area of various rivers draining into the Tal is 13,340 sq.kms against the total submergence area of 1062 sq.km. This indicate that even if the Tal is dry the incoming water from the catchment can appreciably submerge the Tal area even with a moderate runoff say 15 cm (Mokama Technical cum-Development Committee, 1988) from the catchment. Inundation during monsoon period in the Tal area is caused by these rivers as the runoff of this large catchment enters the Tal area.

2. The entry of back water of the river Ganga by back flow through the river Punpun causes water logging in the Tal area.

3. The topography of the area does not have any provision to ensure drainage until Ganga water level itself start receding. Thus often the drainage is delayed and some times goes upto middle of the November. The only drainage of the Tal is

through the river Harohar and a few culverts provided in Patna-Munger P.W.D. road and eastern railway embankments.

4. There is no regulating arrangements in Harohar which could prevent the entry of back water of Ganga through Harohar and also there is no provision to check the entry of back water through P.W.D. road and railway culverts.

5. Inundation is also caused by back flow through valley lines along the Fatuha-Lakhisarai road.

Besides this there are some other reasons e.g. road, bridge, improper land and water management etc. which exaggerate the problem.

4.0 PAST APPROACHES AND ACHIEVEMENTS

Some efforts have been made in the past for identifying the malady of water logging in Mokama Tal and its possible solutions. An account of the chronological development highlighting and discussing these approaches and achievements is presented in following subsections.

4.1 Recommendation of Dr. K.L.Rao (1970 & 1972)

Dr. K.L. Rao, the then Union Minister, Irrigation, visited the Mokama Tal on August 22, 1970. He suggested the following measures:

i Draining out the water from the Tal quickly so that the area is available for cultivation. Presently land is available for second crop only.

ii To provide water for irrigation by Tubewells and pumping from the river Ganga.

4.1.1 Comprehensive Scheme

i To prevent Punpun water coming into the Tal by constructing embankment on the right side of Punpun.

ii Investigation of dam site on the upper reach of the

various rivers that flow into the Tal to retain water.

iii Construction of another 2 or 3 outlets to Ganga for draining the area.

iv Preventing entry of Ganga water into Tal area by constructing Anti-Flood Sluice in Harohar river.

v To confine flooding within embankment by constructing embankment along the both banks of the river if necessary.

vi To prevent flow from various streams into the Tal by constructing parallel drain on the upper reach so that the water of these streams may be trapped there and diverted.

Dr. K.L. Rao visited the Tal area again on 12th July, 1972 and suggested the solutions to the problems which are as follow:

4.1.2 Problems in Tal area

i Water in the Tal must be drained out by 15th October every year.

ii Irrigation water must be available after 15th October

to end June.

iii Water from South side must be prevented from entering Tal low areas.

iv Rabi cultivation gets delayed due to inadequate drainage outlet for in-flood from 5150 sq. miles.

4.1.3 Suggestions

He suggested the following schemes.

i Construction of storage reservoir and embankment on right side of Punpun river to check flow into Tal.

ii Construction of Anti-Flood Sluice on river Harohar.

iii Construction of embankments on both banks of Harohar river with outlet sluice for taking water for irrigation.

For the solution of water logging problem in mokama group of Tal he further stressed for the adoption of following techniques:

a. Adoption of Mathematical modeling and system analysis technique for getting a proper solution of Mokama Tal problem.

b. Setting up of Hydraulic model from Patna to Munger for studying flood control measures of Tal area.

4.2 Recommendation of Sri. C.C. Patel, Secretary, GOI (1976)

A high level technical committee was set up for studying the water logging problem of Mokama Tal. The committee was headed by Sri C.C. Patel, the then Secretary Government of India. On February 5, 1976, the committee inspected the site and suggested the following measures.

4.2.1 Long Term measures

i Construction of reservoir in the upper catchment in the river which enters the Tal area proposed to intercept 25 percent of the total catchment area.

ii To collect all the inflow of rivers, coming into the Tal and to drain them into the river Ganga. It is proposed to construct a drainage channel for this at higher contour on the southern periphery of Tal area.

iii To reduce inflow into the Tal it is proposed to adopt soil conservation measures and contour bounding in the hills on the south of Tal area.

4.2.2 Short-Term Measures

i To stop inflow of Punpun river into Tal areas.

ii Following measures suggested to stop entry of Ganga water in the Tal area and early depletion of Tal water.

a. Construction of Dowel Bundh between Barh and Bariyarpur in the Patna-Munger road where Ganga water overtops the road.

b. To stop the flow of Ganga water through the bridges and culverts in Patna- Munger road and construction of the sluices therein.

c. Construction of marginal bundh from Indupur village to the confluence of Kiul-Harohar-Ganga.

d. Construction of anti-flood sluice in the river Harohar along-with construction of afflux bundh. Sill level of this sluice should be such that some water can be retained in the Tal area for irrigation in the Rabi season.

e. Construction of 13.00 km. long embankment on the right side of the Punpun river to stop back water of Ganga from entering Tal through Punpun river.

f. Construction of a channel on the up stream of the Kuil-Harohar confluence for discharging the flow of Harohar into Ganga directly.

g. "S" loop between Balgudarghat should be made straight.

h. For allround development of the Tal area Tal Development Committee should be formed.

4.3 Recommendation of Mokama Tal Technical-Cum-Development Committee (1988)

The Mokama Tal Technical Committee was constituted by Government of Bihar on November 29, 1982. The terms of reference of Technical committee were as under:

(a) To recommend on the possible schemes to mitigate the water logging problems in the Mokama Tal area.

(b) To recommend about irrigation schemes to provide irrigation facilities in the Mokama Tal area.

The committee submitted an interim report on 18th May 1983, in which the needs for further studies and collection of further data were stressed.

On June 28, 1984, the Mokama Tal Technical Committee

was reconstituted by Irrigation department as Mokama Tal Technical-Cum-Development Committee headed by Shri N.Sanyal. The committee recommended the following measures.

4.3.1. Possible schemes to mitigate the water logging problems

4.3.1.1 Construction of embankment along the right bank of Punpun

Embankment along the right bank of the river Punpun and the river Morhar can prevent inundation caused by the Ganga by back flow through the Punpun. It is proposed to construct an embankment from the rail bridge approach embankment near Fatuha to some few kilometers upstream up to the reach influenced by the back water of the Ganga. This right bank embankment of the Punpun and Morhar is a sanctioned project and is under execution. The project should be expeditiously completed. It will cease back water inundation.

4.3.1.2 Road side dowel/embankment

The committee has noted that Road construction Department has some reservation about the desirability of road side dowel. In case road dowel which should be cheaper than a separate embankment, is not found acceptable to the Road Construction Department embankments in isolated lengths to

prevent entry of the Ganga spill in the Tal area through the low lying of the Road could be constructed.

4.3.1.3 Anti flood sluice

By constructing a suitable anti-flood sluice the inundation caused by the Ganga back flow through the Balgudarghat bridge over the Harohar can be eliminated. As the drainage of the Tal occurs entirely through the Harohar, caution is needed in finalising the dimensions of the water way of the anti-flood sluice, so that there is no vertical or horizontal construction of the available water way. This sluice could be located immediately up stream of the road bridge as the river Harohar has some length of depended bed immediately downstream of the road bridge. The sluice should be a barrage like structure with a crest almost flush with the river bed and on account of head the gate may have to be two tiered or radial.

4.3.1.4 Excavation of channel

Ingress of water of north flowing rivers could be prevented by having a west-east excavated channel, that is an artificial or man made river which shall intercept all these

north flowing rivers before they enter the Tal and carry the water of these intercepted rivers directly to the river Kiul at a higher level where the Kiul shall not be flood-locked by the back water of Ganga. Such a channel shall be costly but the benefits will also be enormous. Once the dug channel is completed the Tal area itself which at times may be more than the requirement of Kharif cultivation. This would mean that almost the entire Tal area of more than one lakh ha can be available for Kharif cultivation as well, where as the present Kharif cultivation is rather a chance crop. Thus, the Tal area developed as a Kharif growing area may be a major break through in the effort of the State to expand the Kharif production.

4.3.1.5 Tal as flood detention basin

Committee reviewed the possibility of using the Tal as a flood detention basin to moderate the peak flow of the Ganga. The cutting off of the flood plain storage accentuates the peak flow in the Ganga which needs to be remedied by suitably located flood moderation detention basins. Mokama Tal already a chronically inundated area can be effectively used as a flood moderation detention basin. In case the scheme materialise, the

cultivators in the Tal area shall have to be given prior warning of a dependable nature before such deliberate inundation, and they shall have to be paid compensation, for the damage due to the deliberate inundation. The modality of such compensation that is whether it will be paid by the centre or the state and weather this can be covered by crop insurance scheme is an issue which has not gone into detail by the committee.

4.3.1.6 Cuts for draining Mokama group of Tals

The issue of expediting the drainage of Mokama group of Tals by having cuts at various possible alternative sites be reviewed after the data of dependable nature be collected for some 7 to 10 years, to adjudge the technical and economic viability of each of the possible cut sites.

4.3.1.7 Cropping pattern

The committee noted the availability of a fairly large range of water resistant varieties of Kharif crop and the rapid pace in which new varieties are being introduced and felt that the Tal area should be classified in different zones with relative degree of proneness and magnitude of inundation so that

the specific variety which would be most suited to the specific characteristic of a particular zone could be introduced there through demonstration plots and other extension services.

4.3.2 Irrigation Schemes to Provide Irrigation Facilities in th Mokama Tal area

4.3.2.1 State tubewells

State tubewells are considerably under-utilised possibly due to the reason, that most of these tubewells are unenergised or are idle due to theft of transformers or inadequate power supply. However few tubewells show significantly good results having encouraging figures of irrigation during different crop season to indicate the existence of suitable aquifer underneath, pointing the possibility of formulation of further programme of irrigation in the area. To solve the difficulties of unsatisfactory functioning of these tubewells, greater attention to maintenance and provision of dedicated power line seem to be necessary.

4.3.2.2 Private tubewells

So far as private tubewells are concerned their availability will depend on the socio-economic condition of the

farmers and their performance will vary with respect to its capacity etc. Their use will depend on the likely return from the crop besides the operating costs etc. However, private tubewells are largely in vogue in this area. The few private tubewells that were surveyed and data put up to the committee show that they have got a very encouraging performance in the area and hence, it must form a part of future planning. Other sources of irrigation like river pumps, it may not be of much significance for the planning for the whole area.

4.3.2.3 Lift irrigation schemes

The area of the Tal north of the Harohar can also be irrigated by lift irrigation from the Ganga, and such lift irrigation schemes could irrigate the high land between the Ganga and the Tal in the first reach and then the low lands of the Tal sloping down to the Harohar in the lower reaches. The channel system in the Tal for such Ganga lift irrigation schemes shall have to be judiciously planned so as to cause least surface drainage obstruction during the wet season. The west-east dug channel, if it ever materialises can also be exploited in a similar manner for irrigating the land south of Harohar.

4.3.2.4 Power and infrastructures

The committee, after careful consideration, came to the conclusion that with ground water and Ganga water being available for irrigation, water would not be a constraint in development of irrigated agriculture in the Tal area. The need of power and the cost of the erection of the infrastructure would however be considerable, and depending on availability of state resources, irrigation in Tal can be developed in stages over a reasonably spread out period.

4.3.2.5 Sluice across the Harohar

Keeping in view all these factors the committee did not favour any sluice across the Harohar for irrigation purpose and felt that the recommended anti-flood sluice near Balgudarghat should not be misused for retaining water in Tal, which may bring in conflicting interest of cultivators of lower land and cultivators of upper land and adversely affect the regime of the river Harohar.

4.3.3 Development Aspects in Mokama Tal Area

4.3.3.1 Prevention of ingress of the Ganga spill

A doubt was raised as to whether prevention of ingress

of the Ganga spill would not reduce the fertility of the Tal, as it would be deprived of the silt brought by the Ganga. In this context the committee noted that after centuries of ingress of the Ganga water and so called deposit of silt on the low land of Tal, the Tal still continues to be a depressed land, indicating that the deposition of fertilising silt must be microscopic in nature as otherwise the Tal should have been filled up as a level land by now. Possibly the effect of silt deposit is confined to the fringe area where the incoming silt gets deposited. The fertilising benefit of this small quantity of silt that might be there shall have to be compensated by natural and artificial fertilizer, like any other inundated area which is made flood free for better agriculture.

4.3.3.2 Effect of Reduced inundation

Some apprehension was expressed before the Committee that reduced inundation may enhance the problems of insects and pests in the Rabi season adversely affecting the crop. This aspect needs further expert study to evaluate the validity of such apprehension but it was felt that this problem can be suitably tackled with judicious agricultural practice proper

selection of type of crop and use of appropriate doses of insecticides and pesticides.

4.3.3.3 Distribution of land

If the development of intensive irrigated Rabi and Hot Weather agriculture is to be achieved after the engineering measures provide the necessary infrastructure, it will be necessary to bring in equitable distribution of land by (a) strict imposition of land ceiling rules and (b) by vacating unauthorised encroachment of Government land by the influential people and (c) distributing the surplus land thus available to landless labourers in economically viable plot sizes.

4.3.3.4 Communication system

Better communication system in the Tal area should be developed, but at the same time care, should be taken that new roads are provided with adequate waterways to permit free passage of Tal water during wet season.

The mobility of the local officers and their functioning can be improved upon by suitable telecommunication or fast vehicles so that social and economic exploitation of the weaker section of the people is effectively guarded against.

4.3.3.5 Planning for disaster prone area

As these villages are likely to be marooned almost every year, suitable deep tubewell drinking arrangement, permanent grain storage arrangement and stock of essential medicines have to be planned, as in disaster prone areas. The Tal administration should have low draft stable power boats for patrolling and relief during inundation period. In case the Tal is to be developed as a flood detention basin, the villages must have dependable flood warning facility.

4.3.3.6 Need for Tal Development Authority

As the agriculture development in the Tal would depend on extension services, marketing and storage facility and growth of agro-based industries, a Tal development authority has to be developed to do the function of the Command Area Development Authorities in a more meaningful manner.

4.3.3.7 Imposition of levy

As the measures suggested for the Tal would bring in basic improvement in the productivity of land and quality of life and would be needing considerable investment, some sort of betterment levy can be imposed in the Tal apart from the

irrigation charge, so that some part of the investment may be realised from the beneficiaries.

4.3.3.8 Vertical drainage of Tal

If future studies indicate that vertical draining of the Tal to the lower aquifer shall benefit the neighbouring aquifer in a tangible manner, than this could be taken as a programme of charging the aquifer, for subsequent ground water exploitation, and any benefit that thus would be occurring to the Mokama Tal being of a secondary nature.

4.4 Suggestions by Second Irrigation Commission

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

4.4.1 Construction of anti-flood sluices

Out of five proposed cuts on Patna-Munger road at Rukunpura, Rewaih, Ralley, Kanhaipur and Hemza it is suggested

that if any cut has to be taken up for trial basis, then it appears to be Hemza. There are seven bridges in Barahiya-Lakhisarai road between the proposed Hemza cut and Balguderghat bridge on the Harohar river. The drainage efficiency of the approach channels from the Tal to these bridges and exit channels from these bridges to the Ganga have been reduced to a large extent due to encroachment. Therefore, by clearing these encroachments and making the bridges functional early clearance of the Tal area may be achieved as soon as the Ganga level go down at different outfall points.

4.4.2 Raising and Strengthening of Zamadari Embankments

Members of the commission had visited the Tal area and observed that the Zamindari bundhs(embankments) have been constructed to protect the Kharif growing areas in the fringe of Tal from deep submergence. For raising and strengthening of 74 nos of embankments the Govt may provide necessary technical and financial assistance.

4.4.3 Renovating Pynes

Some of the commission Members visited one of the channels renovated by cutting existing channels connecting local

depression in the Tal with main outlet channel, i.e. the Harohar. They observed that regulator on this channel as well as others like this would not be able to fulfill the objective of storing any water for Rabi. View of the commission is against all 63 nos. of Pynes (16 nos. renovated in Phase I of Scheme and 47 remaining).

4.4.4 Closure of Culverts and Construction on Anti-Flood Sluice

It is suggested to close 13 nos. of culverts on Patna-Munger road and to provide anti-flood sluice in 2 nos. of culvert only.

4.4.5 Construction of tanks/ponds in Tal area

Feasibility of constructing adequate number of large sized tanks/ponds on higher patches in the Tal, to hold back as much water of the Tal as possible for use in Rabi and Hot Weather irrigation should be examined and schemes found feasible be taken up.

4.4.6 Construction of high level land on southern periphery

From west to east on the southern periphery of the Tal area the possibility of constructing a high level road may be

investigated and its execution be taken up if found economically and technically viable. This road will cross all the streams entering the Tal. Gated regulators-cum-bridge may be constructed at the crossing of the streams to hold back water behind the regulators forming ahars on the south/west of the road. This water could be utilised for irrigation during Rabi/hot weather season.

The Commission does not however feel optimistic about the usefulness of a high level west-east drainage canal, proposed in some reports to drain all the monsoon waters of rivers coming in the Tal from south to the river Kiul at a higher level to prevent their entry into the Tals. It is apprehended that this may amount to creation of another Tal above the present one, at a huge cost, wasting lot of cultivable land.

4.4.7 **Construction of Barrage across the Punpun**

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

4.4.8 Development of private tubewells

For the development of private tubewells all possible incentives may be given to the cultivators.

4.4.9 Points to ponder

To provide irrigation in the Tal area either through a lift pump canal from the Ganga or through a string of State tubewells on the periphery of the Tal, the following points should receive serious consideration of the Govt before taking a final decision:

i. In both the cases large chunk of electrical energy is needed in both cases.

ii. Large amount of subsidy involved in both the cases if they are owned and operated by the State Govt.

iii. Problem of their maintenance on operation and efficiency of performance in light of the experience in maintenance and operation of existing State tubewells.

iv. Suitably or otherwise of open surface irrigation channels versus underground irrigation channels in view of submergence of the Tal area during monsoon season.

The committee feels that it is desirable to draw the attention of the Government towards the fact that Dr K.L.Rao, the then Union Irrigation Minister, in the year 1972 suggested adoption of mathematical modelling and system analysis techniques for getting a proper solution of Mokama Tal problems and setting up of hydraulic model from Patna to Munger for studying flood control measures of Tal area. But it is sad to note that so many years have passed but the above model tests could not be held as yet. Had these been done, it would have been known more precisely whether the five proposed cuts on the Patna-Munger road could be effective or not.

5.0 REMEDIAL MEASURES ADOPTED SO FAR

Govt of Bihar accepted some of the recommendations pertaining to development of the land and water resources of the Mokama Tal areas. Water resources department, Govt of Bihar had prepared the schemes for tackling the problem in phased manner.

5.1 Phase I of Scheme

Phase I of the schemes was prepared to execute the following works.

(i) Excavation and renovation of drainage channels connecting low lying pockets with trunk river Harohar, Mohane and Dhowa.

(ii) Construction of bed-bar cum regulator at the outfall of each drainage channel into Harohar in order to prevent to retrogression and also to regulate flood water.

The scheme is prepared to achieve two objectives (i) accelerating drainage during the kharif season and (ii) storing water especially during winter rains in December and January for Rabi irrigation. These works for cutting and renovating 16 numbers of existing channels connecting local depressions in the

Tal with the main outlet channel, i.e. the Harohar were taken up for execution in 1967 and were completed in 1969. However, the wooden karries were subsequently lost and at present a scheme has been taken up to provide manually operated vertical lift shutters of steel. Some of the members of the Commission visited the regulator site and found that the steel shutters were lowered in the process of installation. They observed that this regulator as well as others like this would not be able to fulfill the objective of storing any water for use in Rabi.

5.2 Phase II of Scheme

For the development of Tal area many schemes were prepared. Construction of Punpun right bank embankment in a length of 14 km was approved by the Govt. It is reported that 60 percent have been completed. The remaining work is reported to be held up due to public objections in the earlier years and perhaps due to paucity of funds in the recent past. The embankment is expected to prevent the spill of the Punpun river and the back water of the Ganga through the Punpun from entering the Tal areas from the Fatuha end. This embankment may certainly provide much relief to Fatuha and Bakhtiarpur Tals.

5.3 Phase III of Scheme

The third phase of the scheme include provision of storage dams in the hilly catchment of the north flowing rivers into the Tals. Harohar which flows from west to east in the middle of the Tal receives water from various rivers originating from South Bihar hills. The Tal areas get filled up primarily due to inflow of these rivers. For providing real relief from extent and duration of submergence in the Tal area the importance of reservoirs, weirs, ahars, tanks, pynes and canals etc. in the catchment above the Tal in the south is visualised. Various storage dams (Table 5.1) suggested in the hilly catchments of the rivers flowing into the Tal.

Table 5.1 Storage Dams Suggested on the Rivers Flowing into the Tal

Sl.No.	Name of the Reservoir	River
1.	Fulwaria reservoir	Tilaiya
2.	Dhadhar reservoir	Dhadhar
3.	Lilajan reservoir	Lilajan
4.	Mohane reservoir	Mohane
5.	Sakri reservoir	Sakri
6.	Job reservoir	Job

5.4 Priorities for future works

The State Govt is planning to execute further works to reduce the submergence and facilitate agricultural operation in the tal areas. These works are explained below.

1. It is decided to construct five cuts with anti-flood sluices at Rukunpura, Rawaich, Ralley, Kanhiapur and Hemza on Patna-Munger road with antiflood sluices to drain the Tal water into Ganga.

2. Raising and strengthening of 17 nos. of Zamidari embankments located at different places in the Tal areas.

3. There is a plan to renovate 63 nos. of Pynes.

4 Closure of 13 nos of culverts on Patna-Munger road to stop entrance of the Ganga water into the Tal.

5. Providing anti-flood sluices in two culverts on Patna-Munger road to expedite drainage of Tal as soon as the Ganga water level permits it with antiflood sluices on them.

6.0 CONCLUSION

The Mokama group of Tals is fed by several north flowing rivers of South Bihar draining into it. The only drainage of the Tal is through river Harohar. During Monsoon period inflow from north flowing river and back water of river Ganga often delays the drainage. Most of the Tals get submerged almost in 80 to 90% of the year with degree of submergence of 50% and more of the Tal area. This is a very unique situation. Due to submergence of the Tal area, during monsoon optimum utilisation of its land resources is hampered particularly during Kharif season. The Rabi crop also suffers if somehow the drainage of the Tal is delayed beyond the 15th of October. There are various possible reasons perceived (Fig6.1) for the long felt problem of the Tal area. The ultimate solution can be obtained by hitting the problem at different angles. These can be categorized as:

(a) Restricting catchment runoff entering into the Tals

(i) Diversion of water of North flowing rivers of South Bihar through guided channels into the River Ganga directly and through the river Kiul.

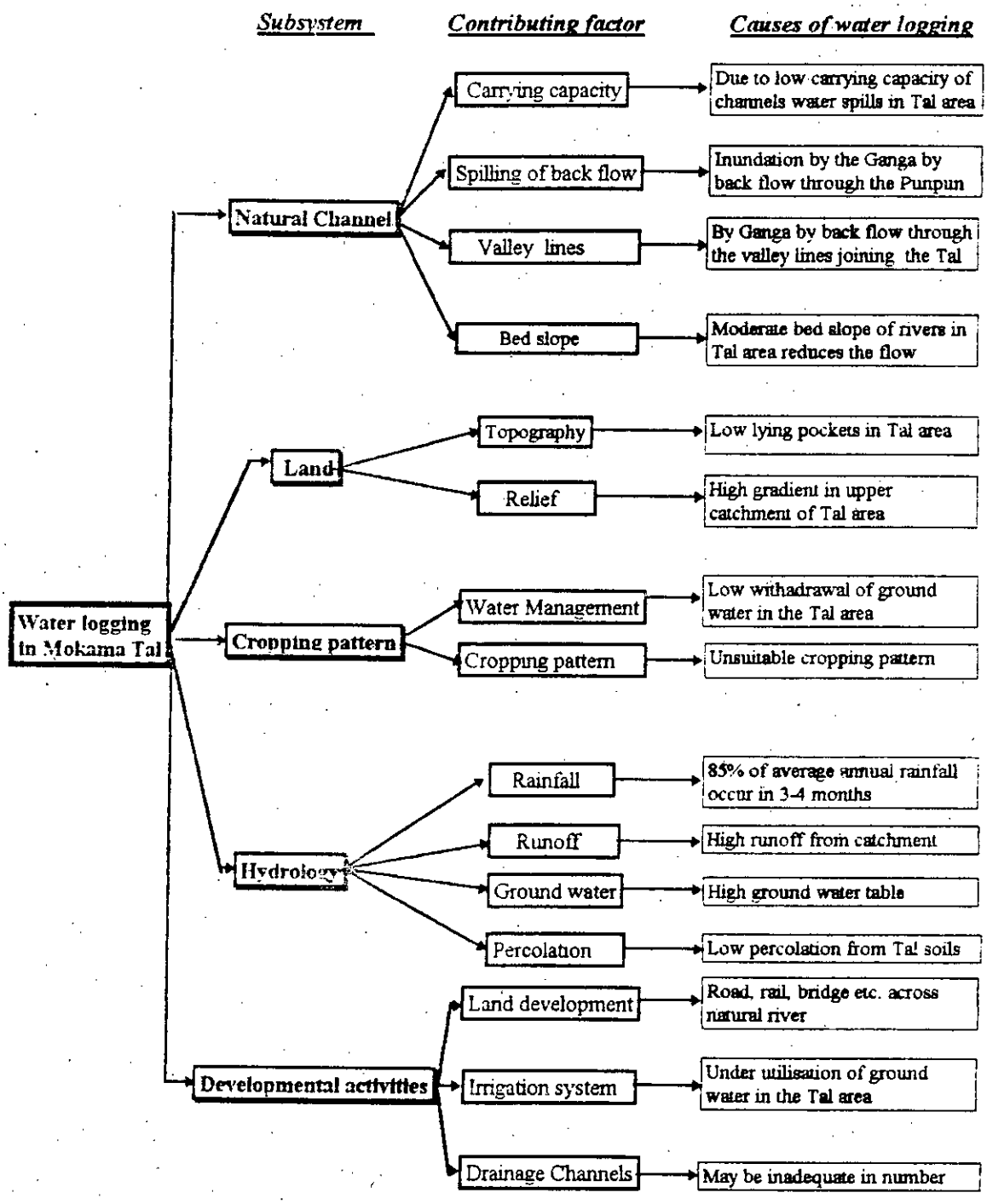

FIG. 6.1 : POSSIBLE CAUSES OF WATER LOGGING IN MOKAMA GROUP OF TALS

(ii) Construction of storage reservoirs on these rivers.

(b) Preventing Ganga Back Flow into the Tals

Construction of embankment, anti-flood sluices and Dowels on road.

(c) Providing additional drainage channels

To work out for the additional drainage channels with anti-flood sluice on them.

(d) Channel Improvement

Drainage capacity of the channel can be improved by cleaning, widening and deepening them. Effect of the channel improvement should be carefully examined.

(e) Improving the Irrigation Facilities

Providing distribution canal system in the storage reservoirs mentioned in (a) and pump canals from Ganga and Harohar rivers. Increasing the irrigation during Rabi and Hot weather by more number of tubewells.

Committees constituted by the Govt. and various individuals have suggested several measures for the Tal area. The available material on the waterlogging problem in Mokama Tal

indicates that a very few suggested schemes are adopted/completed so far. It is felt that more detailed studies should be carried out on some of the important aspects responsible for the waterlogging problem.

7.0 RECOMMENDATIONS

Following studies are recommended in the Tal area.

1. For computation of extent, duration and frequency of submergence field data and remote sensing data should be integrated through a geographic information system.
2. In most of the study it is suggested to construct reservoirs in some of the river contributing in the Tals. It is suggested to carry out a study for optimum utilisation of water in proposed reservoirs and its overall effect in water logged area.
3. The effect of various schemes implemented partially/fully should be evaluated.

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