CHAPTER I

GENERAL

ORIGIN OF THE NAME OF THE DISTRICT

The district of Sonipat came into existence on December 22, 1972.[1] It was a part of Rohtak district till December 21, 1972.

Sonipat seems to be a corruption of the word Sonpat which means in Sanskrit language the *suvarna prastha* (gold place). One popular tradition avers that this is one of the five *patas* or *prasthas*[2] (Indraprastha, Panipat, Talpat, Bhaghpat and Sonipat) mentioned in the *Mahabharata* which Yudhishthira demanded from Duryodhana. Another tradition ascribes its foundation to Raja Soni thirteenth descent from Arjuna, a brother of Yudhishthira.[3]

LOCATION, BOUNDARIES, AREA AND POPULATION

Location and boundaries.—The district lies between 28°48′ 30″ and 29° 17′ 54″ north latitude and 76°28′ 30″ and 77°13′40″ east longitude. It is bounded by the Karnal[4] district on the north. To its north-west and west is Jind district. To its south-west and south are the Rohtak district and Delhi respectively. The Yamuna river marks the eastern boundary of the district and across the river lies Meerut district of Uttar Pradesh.

Area.—With an area of 2,206 square kilometres[5], it occupies 4.99 per cent of the total area (44,212 square kilometres) of the State. It ranks eleventh in size among the 12 districts of the State.

Population.—According to 1981 Census, the district had 8,46,765 persons, 4,53,873 males and 3,92,892 females. It ranks population-wise eleventh among districts with 6.35 per cent of the total population of the State.

HISTORY OF THE DISTRICT AS AN ADMINISTRATIVE UNIT

The areas comprising the Sonipat district underwent many changes before the administrative unit in its present form emerged. Being close to the imperial city of Delhi, Sonipat was one of the three tahsils of the Delhi district.

1. *Vide* Haryana Government Notification No. 6054-E-(iv)-72/45724, dated December 22, 1972
2. *Marathas And Panipat* by Hari Ram Gupta, 1961, p. 176.
3. *Imperial Gazetteer of India (Privincial Series)*, 1908 Vol. I, p. 301.
   (It is said that Lahrahara village of Sonipat tahsil was the Capital of King (Soni).
4. The Panipat district was created on 1st November, 1989.
5. The area of the district has been calculated on the basis of number of villages (348) as per Census of 1981. Two villages of Ganaur tahsil have been transferred to Panipat tahsil on 30th December, 1982.

Sonipat Tahsil.—The Delhi territory was first divided regularly into districts in 1819. The district of Delhi, as then constituted, consisted of two *parganas*, the 'northern' and the 'southern'. Between them they comprised the Delhi tahsil, the northern portion of the then Ballabgarh tahsil and a small portion then included in the Rohtak district. The Sonipat tahsil, with its headquarters at Larsoli, formed the Larsoli *pargana* of the Panipat district.[1]

When the British took over the other areas after the treaty of Surji Arjungaon in 1803, the portion comprising the present Panipat tahsil and a part of Karnal tahsil became a part of Delhi Territory. In 1819, the Delhi Territory was reorganised into four parts which were the beginnings of the districts of Delhi, Rohtak, Gurgaon and Hisar. The Panipat district, including the areas of Panipat, Karnal and Sonipat, was formed as the fifth district in the reorganisation of 1824.

The arrangements as to tahsils appear to have been as follows :—

> "As regards Sonipat tahsil there were at first two tahsils, both having their headquarters at the town ; then another, a small one, with a very poorly paid tahsildar, was made up at Ganaur. This was the State of things in 1835, When (1) Sonipat *Bangar* had a tahsildar drawing Rs. 50/- a month and the revenue was Rs. 2,13,040/-; (2) Sonipat *khadar*, a tahsildar on Rs. 50/- and revenue Rs. 70,999 ; (3) Ganaur, a tahsildar on Rs. 30 and revenue Rs. 67,444. In 1836, the Ganaur tahsil was incorporated with the the Sonipat *khadar*. Tnis administration continued till 1851, When the two Panipat tahsils were made one, and the same amalgamation took place at Sonipat, the one tahsil being called Larsoli.[2]"

After the mutiny and the transfer of the Delhi territory (including Sonipat tahsil) to the Punjab, the immediate charge of Delhi district was held first by the Principal Assistant and subsequently by the collector under the Resident and Civil Commissioner. The first partition of Delhi-territory was made into divisions, an Assistant being entrusted with the charge of a division. At that time Sonipat formed part of the northern division with headquarters at Panipat.

In August, 1868, six villages with a population of 5,841 were transferred from Rohtak to Sonipat. In 1872, the number of villages in Sonipat tahsil was 211 but this number was increased to 241 in 1880.

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1. *Gazetter of the Delhi District*, **Part A.** 1912. P 42.
2. *Ibid*, pp 42-43.

The Sonipat tahsil, which had remained attached to the Delhi district since the year, 1861, was added to the Rohtak district in September, 1912, on the separation of Delhi territory from Punjab.

Gohana tahsil and other areas.—By the treaty of Surji Arjungaon, signed on December 30, 1803, Rohtak area with some areas of present Sonipat district was taken over by the British and came under the administration of North-Western provinces. The British had no intention at that time to hold large territories beyond the Yamuna. Hence a large part of acquired territories during Anglo-Maratha War was divided among the loyal Kings who helped the British during the above war. Gohana and Kharkhoda-Mandothi were given to Raja Bhag Singh of Jind and Bhai Lal Singh of Kaithal as life jagirs.

The Gohana and Kharkhoda-Mandothi estates lapsed to the British Government on the death of Lal Singh in A.D. 1818 and Bhag Singh in 1820. The places such as Gohana, Kharkhoda and Mandothi were included in the Rohtak district in 1824.

Rohtak district was abolished in A.D. 1841; Gohana going to Panipat, and the rest of the tahsils to Delhi but it was created again in 1842. The Rohtak district with a large territory forming the present Sonipat district remained a part of Hisar division until 1884.

On abolition of Hisar division in 1884, the above territories with other areas of Rohtak district were transferred to the Delhi division. After the separation of Delhi territory from Punjab, the district was attached to the Ambala Division. This position remained upto 1947.

From 1912 to December, 1972, the present Sonipat district was a part of Rohtak district. It came into existence on December 22, 1972. At the time of formation of Sonipat district, 16 villages of Rohtak tahsil were transferred to Sonipat tahsil. The tahsilwise position of the villages on the eve of the formation of the district was as under :—

Tahsil		No. of Villages
(i) Sonipat	..	257
(ii) Gohana	..	89

The following territorial changes took place in the Sonipat district between April 23, 1974 and June 11, 1974 :—

Detail of the Notification	Remarks pertainng to changes
Vide Haryana Government Notification No. 2278-R-(iv)-74/ 11547, dated April 23, 1974	3 villages (Sisana, Garhi Sisana and Ashrafpur Matindu) were transferred to Sonipat tahsil from Rohtak tahsil and on the same day Polangi village of Sonipat tahsil was added to Rohtak tahsil.

Vide Haryana Government Notification No. 3059-R-(iv)-74/ 19358, dated June 11, 1974	5 villages (Guhna, Tihar, Bhadi, Rolad Latifpur and Dodwah) from Sonipat tahsil were transferred to Gohana tahsil.

By taking 69 villages from Sonipat tahsil, Ganaur as sub-tahsil was created on February 18, 1980. Three villages, namely, Rolad Latifpur, Dodwah and Bhadi of Gohana tahsil were transferred to Ganaur sub-tahsil on December 4, 1980. However, 2 villages (Chulkan and Chhadya Yusafpur) of Ganaur Sub-tahsil were transferred to Panipat tahsil of Karnal district on 30th December, 1982.

Kharkhauda with 38 villages was created as a sub-tahsil on March 30 1982. The Sub-Tahsil of Ganaur was upgraded to the level of full-fledged tahsil on April 19, 1982.

Thus, the Sonipat district, on March 31, 1983, comprised 346 villages (335 inhabited and 11 un-inhabited).

The tahsilwise details of villages are as under :—

Tahsil/Sub-tahsil		No. of Villages
1. Sonipat	..	147
2. Gohana	..	91
3. Ganaur	..	70
4. Kharkhoda (Sub-tahsil)	..	38
Total:		346

As far as one village (Dodwa with its *hadbast* No. 148) of Ganaur tahsil and two villages Guhna, 184 and Tihar, 183 of Gohana tahsil were transferred to Sonipat tahsil[1].

On February 15, 1984, Chulkana village was again transferred from Samalkha sub-tahsil of Karnal district to Ganaur tahsil of Sonipat district.[2] A referendum was held at Chulkana village about its future and again this village was transferred to Samalkha tahsil.[3]

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(1) *Vide* Haryana Govt. notification No. 156-E (iv)-84/4270, February 15, 1984.

(2) *Vide* Haryana Govt. Notification No. 156-E (iv)-84/4267, dated February 15, 1984.

(3) *Vide* Haryanz Govt. Notification No. 2816-E (iv)84/15239, dated May 31, 1984.

The villages, viz. Dobaita, Moi, Majri, Rolad Latifpur and Bhadi of Ganaur tahsil were transferred to Sonipat tahsil, whereas as far as 3 villages Beghan, Sandal Kalan and Chatia Aulia of Sonipat tahsil were transferred to Ganaur tahsil on August 5, 1985.[1]

On August 5, 1985, village Rohna of Rohtak district was transferred to Kharkhoda Sub-tahsil. On the same date, 6 villages (Barona, Khurampur, Pai, Kirauli, Pahladpur and Sohoti of Bahadurgarh tahsil (Rohtak district) were transferred to Kharkhoda sub-tahsil of Sonipat district.[2]

There were 353 villages in the district as on March 31, 1989. The details are as under[3] :—

Tehsil	Villages		
	Inhabited	Un-inhabited	Total
Sonipat ..	147	5	152
Gohana ..	86	3	89
Ganaur ..	63	4	67
Kharkhoda (Sub-Tahsil) ..	44	1	45
	340	13	353

GEOLOGY

The Sonipat district falls in the Great Indo-Gengetic Alluvial plain and the entire district is covered by Quanternary deposits. The area is conspicuously flat and has a master slope from north to south.

The Quaternary sediments of the area are composed of recent and fresh matter deposits of clay, silt and sand which are of loose to semi-consolidated nature of recent to sub-recent age. The Geological classification of the sediments depending upon relative disposition, occurrence, development of soil thickness oxidation etc. has been broadly made into two formations viz. the Older Alluvial Formation and the Jamuna Older Alluvial Formation. The details of which are as follows :

The Older Alluvial Formation.—It occurs at higher level and chiefly consists of silt, silty clay and clay with occurrence of *kankar* at certain places. The colour of the sediments varies from dirty yellow to pale brown due to oxidation.

(1) *Vide* Haryana Govt. Notification No. 4649-E(4)-85/23546, dated 5th August, 1985.

(2) *Vide* Haryana Govt. Notification as shown above.

(3) The Gohana Sub-Division of Sonipat district was included in the Rohtak district—*vide* Haryana Govt. Notification S.O. 156/P. A. 17/1887/S.5./89, dated 16th October, 1989

Jamuna Older Alluvial Formation.—It occurs concomitant to the Jamuna channel in the form of recent flood plain and low lying terrace deposits. It consists of greyish silt, silty sand with sporadic pebbles of quartzites basic rock fragments and clay pockets.

Economic Minerals

The following minor minerals are recovered from the earth :—

Sand.—It occurs in abundance and is being used in concrete mixture for construction.

Brick Clay.—The silty clay is used for brick making.

Saltpetre.—The material is used for washing of clothes by local washermen. It is reportedly being marketed to Lucknow and Calcutta. It is recovered mainly during summer season.

Most of the saltpetre is manufactured in the villages of the Gohana and Sonipat tahsils.

FLORA

There has been no systematic survey and there is nothing particular about the flora of the Sonipat district. However, the various kinds of trees and shrubs grow in different localities are given below :—

Serial No.	Local name	Botanical name
1	2	3
1.	*Pilu* or *Jal*	*Salvadora Oleoides*
2.	*Jand, Janti, Chonkra*	*Presopis cineraria*
3.	*Karil* or *Kair*	*Capparis decidua*
4.	*Hingo* or *Tingota*	*Balanites acjyptiaca*
5.	*Hins*	*Capparis sepiaria*
6.	*Kutra Kundru, Kanduri*	*Cocceinea cordifolia*
7.	*Hul hul*	*Cleome viscosa*
8.	*Kanteri, Kankawwa, Kana*	*Commelina*
9.	*Khurand, Bohphali, Howwa-torai Kagroti, Chonch, Kharenti*	*Corchorus*

1	2	3
10.	*Kundra* or *Tandla*	.. *Digera arvensis*
11.	*Kulfa*	.. *Portulaca*
12.	*Jhojhru* or *Pawad*	.. *Tephrosia*
13.	*Santhi*	.. *Trianthemo*
14.	*Bhankdi*	.. *Tribulus alutus*
15.	*Kasni* or *Kasni*	.. *Triumfetta tomentosa*
16.	*Basuti*	.. *Adhatoda vasica*
17.	*Bangra* or *Bichhu* or *Kutra* or *Bhurat*	.. *Xanthium strumarium*
18.	*Ak* or *madar*	.. *Calotropis procera*
19.	*Kala Bhangra*	.. *Croton bonplandianum*
20.	*Satyanashi* or *Kateli*	.. *Argemone mexicana*
21.	*Katchi* or *Rissa*	.. *Cnicus arvensis*
22.	*Farash*	.. *Tamarix articulata*
23.	*Shisham*	.. *Dalbergia sisoo*
24.	*Babul* or *Kikar*	.. *Acacia nilotica*
25.	*Reru*	.. *A. leucophloea*
26.	*Siris*	.. *Albizzia lebbeck* (B.)
27.	*Nim*	.. *Azadirachta indica*
28.	*Dhak*	.. *Butea monosperma*
29.	*Peepal*	.. *Ficus religiosa*
30.	*Amaltas*	.. *Cassia fistula*
31.	*Lasura*	.. *Cordia dichotoma*
32.	*Bar* or *Banyan*	.. *Ficus bengalensis*
33.	*Sahtoot*	.. *Morus alba*

1	2	3
34.	*Jumela*	.. *Terminalia arjuna*
35.	*Kachnar*	.. *Bauhinia variegata*
36.	*Barna*	.. *Crateva nurvala*
37.	*Sohanjna*	.. *Moringa Oleifera*
38.	*Kaim*	.. *Mitrogyna Parvifolia*
39.	*Semul* or *Symbal*	.. *Salmalia malabarica*
40.	*Lahura*	.. *Tecomella undulata*
41.	*Chhittar, Thohar* or *Nagphani*	.. *Opuntia dillenii*
42.	*Aam*	.. *Mangifera indica*
43.	*Jamun*	.. *Syzygium cumini*

The aquatic flora of the district includes such flowering plants as *Aponogeton ceratophyllum* and species of *Hydrilla, Nymphaca* (*Chhota Kamal*), *Potamageton, Trapa bispinosa* (*Singhara*), *Utricularia* and others; and also species of *Morsilea* and *Azolla* of the *Bteridophyta-group.*

There are many herbs and shrubs which possess medicinal properties. Some of the more important are :

Boerhaavia diffusa (*Punarnava*), *Argemone mexiana*(*Satyanasi*), *Peganum harmala* (*Harmal*), *Solanum surattense*(*Kandiasi*), *vitex negundo* (*Nirgundi*), *Withania somifera*(*Asgand*) and *Zyuyphus* spp.

There are many kinds of grasses in the district. The biggest and the most conspicuous is *Saccharum Munja* (*Munj* or *Sarkanda*).This grass is put to various uses and yields fibre from which strong ropes are made.A very good fodder grass is *Cynodon dactylon* (Dub). Other grasses commonly seen are *Eragrostis, vetiveria Zizanoides* (*Khas-khas*)*Dacthloctenium aegyptium* (*Makhra* or *Madna*), *Cenchrus Cilaris, Echinochloa colona, Heteropogon contortus, Polypogon* Sp. etc.

Adhatoda vasica (*Bansa*) and *vitex negunda* (*Sambhalu*) are used as roofing material for mud-houses. The grasses like *dub* and *Kans* are used to feed cattle. Other grasses like *Sanwak, dub, deila* and *bathu* are very harmful for crops but provide good fodder for cattle.

FAUNA

Mammals.—The district is devoid of forests, there is hardly any chance of a big mammal being met in the district. Black buck, *Antilope Cervicapra* (Linnaeus) is perhaps the only big mammal which can be seen in the district and its presence is confirmed in the adjacent Rohtak district. Rodents are represented by Five striped Palm Squirrel, *Funambulus Pennalti* (Wroughton), Indian Gerbille, *Tetera indica* (Hardwicki), house rat, *Rattus rattus* (Linenaeus) and the house Mouse, *Mus musculus* (Linnaeus). The insect-eating mammal, *Suncus murinus* (Linnaeus) commonly known as '*Chuchundar*' is quite Common. Two species of bats, namely; Common Yellow Bat, Scotophilus heathi (Horsfield) and Tickell's Bat, *Hesperoptenus tickelli* (Blyth) are seen in the district. The Indian Hare, *Pepusnigricollis* Cuvier or *Khargosh* is also seen in bushes and cultivated fields. Among the carnivores, Jackal, *Canis aureus* (Linnaeus) and Small Indian Civet, *Viverricula indica* (Desmarest) may be found in the district. The common Mongoose, *Herpestes edwardsi* (Geoffroy) is quite common in the area. The Primates, the highest group of mammals are represented by Rhesus Macaque *Macaca Mulata* (*Zimmermann*). One more primate species, the Common *Langur, Presbytis entellus* (Dufresne) is found here.

Birds

Water birds.—A large number of migratory ducks visit various tanks and lakes in the district during winter. These include Brahminy Duck, *Tadorna ferruginea* (Pallas) ;Common Shelduck, *Tadorna tadorna* (Linnaeus); *Pintail, anas acuta* (Linnaeus); Common Teal, *Anas crecca crecca* (Linnaeus); Mallard, *Anas platyrhynchos* (Linnaeus) ; Gadwall, *Anas streperastrepera* (Linnaeus) ; Wigeon, *Anas penelope* (Linnaeus) ; Bluewinged Teal, *Anas querquedula* (Linnaeus) ; Shoveller, *Anas clypeata*(Linnaeus) ; Common Pochard, *Aythya ferina* (Linnaeus) ; etc. Some other ducks such as Cotton Teal, *Nettapus Coromandelianus coromandelianus* (Gemelin) ; Spotbill duck, *Anas pcecilorhyncha* Forster, etc. occur there throughout the year at suitable habitats.

Besides a good number of birds like Dabchicks, *Podiceps ruficollis capensis*(Salvadori) ; Large Cormorant, *Phalacrocorax carbo sinensis*(Shaw); Little Cormorant, *Phalacrocorax niger* (Vieillot) ; Darter or Snake bird, *Anhinga rafa melanogaster* Pennant ; Eastern Grey Heron, *Ardea cinerea* rectirostris Gould ; Little green Heron, *Butorides striatus chloriceps* Bonaparte and Paddy Bird, *Ardeola gravii grayii* (Sykes) are found near the Ponds and lakes of the district throughout the year. Other birds like Eastern large Egret, *Egretta alba modesta* (J.E. Gray) ;Median Egret, *Egretta intermedia intermedia* (Wagler) ; Little Egret *Egretta garzetta garzetta*(Linnaeus) and little Bittern, *Ixobrychus minutus minutus* (Linnaeus) affect inland water marshes, jheels, etc. Cattle Egret, *Bubulcus ibis Coromandus* (Boddaert) can be seen moving along with grazing cattle.

A large number of painted stork, *Idis leucocephalus* (Pennant); Openbill stork, *Anastomus oscitans* (Boddaert) ; whitenecked stork *Ciconia episcopus episcopus* (Boddaert) ;Blacknecked strok *Xenorhynchus asiaticus asiaticus* (Latham); White Ibis *Threskiornis melanocephala* (Latham); Indian Black Ibis *Pseudibis papillosa papillosa* (Temminck) are also found near marshes and inundated land and cultivated fields throughout the year. Black stork *Ciconia nigra* (Linnaeus) visits the district during winter season. Adjutant stork *Leptoptios Dubius* (*Gmelin*) can be seen during rains. Spoonbill *Platalea leucorodia* major Temminck and schlegel may also be seen along *Jheels* during winter.

Among cranes Eastern Common crane *Grus grus lilfordi* Sharpe and Demoiselle Crane, *Anthropoides virgo* (Linnaeus) are found in association on sandy river beds, *Jheels* and fields of winter Crops. Indian Sarus crane,*Grus antigone antigone* (Linnaeus) is a resident bird and breeds during monsoon.

During winter, Baillon's crake, *Porzana pusilla pusilla* (Pallas) and spotted crake, *Porzana porzana* (Linnaeus) can be seen on the edges of ponds and lakes feeding on aquatic plants. Indian Bluebreasted Banded Rail, *Rallus striatus albiventor* Swainson ; Slatylegged Banded Crake, *Rallina eurizonoides amauroptera* (Jerdon) ; Northern Ruddy crake , *Amaurornis fuscus bakeri* (Hartert); Chinese White breasted Waterhen, *Amauronis phoenicurus chinensis* (Boddaert); ;Indian Moorhen, *Gallinula chloropus indica* Blyth ; Indian Purple Moorhen, *Porphyrio porphyrio policephalus* (Latham) are resident species of the district and canbe seen on rain-filled ponds and inundated paddy cultivation, etc. Coat, *fulica atra atra atra* (Linnaeus) is resident as well as winter visitor and affects *Jheels* and tanks.

The Waders, namely ; Dusky Redshank *Tringa erythropus* (Pallas); Eastern Redshank, *Tringa totanus eurhinus* ((Obeholser); Marsh Sandpiper, *Tringa stangnatlilis* (Bechstein) ; Greenshank, *Tringa nebularia* (Gunnerus); *Green* Sandpiper, *Tringa Ochropus* (Linnaeus); Wood Sandpiper, *Tringa glareola* (Linnaeus), Common Sandpiper, *Tringa hypoleucos* (Linnaeus) ;Pintail snipe, *Capella stenura* (Bonaparte) and Temminck's stint, *Calidris temminckii* (Leisler) visit suitable marshy areas and the edges of pools and lakes during winter. On the other hand, pheasant tailed jacana, *Hydrophasianus chirurgus* (Scopoli) and Indian Blackwinged stilt, *Himantopus Himantopus himantopus* (Linnaeus) are residential birds and effect *jheels*, marshes and village tanks, etc.

Some other birds which are found near the river in the district throughout the year are : Indian River Tern, *Sterna aurantia* J.E. Gray and Blackbellied Tern, *sterna acuticauda* J.E. Grey. White whiskered Tern, *Chilonais hybrida indica* (Stephens) is a winter visitor.

It is not uncommon to see kingfishers like Indian Pied Kingfisher, *Ceryle rudis leucomelanura* Reichenback ; Indian Small Blue Kingfisher, *Alcedo atthis bengalensis* Gmelin and Whitebreasted Kingfisher. *Haclyon smyrenensis smyrnensis* (Linnaeus) goes hurling itself headlong into water to catch fish. All these are resident birds and affect every kind of stagnant water and canals.

In addition to ducks and geese, other game birds like partridges nnd quails are commonly seen. Indian Black Partrige, *Francolinus francolinus asiae* Bonaparte and Grey Partridge, *Francolinus pondicerianus interpositus* Hartert are Common. Grey quail, *Coturnix coturnix coturnix* (Linnaeus) is a seasonal (Winter) visitor, while Blackbreasted Or Rain quail, *Coturnix cormandelica* (Gmelin) ; Jungle Bush quail, *Perdicula asiatica punjaubi* Whistler and Rock Bush quail, *Perdicula argoondah* (Sykes) are resident species.

Sandgrouses, namely the Large Pintail Sandgrouse, *Pterocles alchata* (Linnaeus) and the Indian Sandgrouse, *Ptercoles exustus* Temminck are aslo resident birds. Their flocks, large and small, regularly visit some favourable waterholes.

Among Pigeons and doves, Bengal Green Pigeon, *Treron phoenicoptera* (Latham) is found in the vicinity of villages chiefly on *Ficus* trees. Blue Rock Pigeon, *Columba livia* Gmelim occurs in almost all the villages. Indian Ring Dove, *streptopelia decaocto* (Frivaldszky) and Indian Spotted Dove, *Streptopelia chinensis* (Scopoli) are generally found in all cultivated fields.

Colourful birds.—The colouiful birds add beauty to the varied wild-life of the district. The most comon birds are : Large Indian Parakeet, *Psittacula eupatria* (Linnaeus); Rose-ringed Parakeet, *Psittacula krameri* (scopoli); common Kingfisher, *Alcedo atthis* (Linnaeus); whitebreasted Kingfisher, *Halcyon smyrnensis* (Linnaeus); Blue-cheeked Bee-eater, *Merops superciliosus* (Linnaeus); Goldenbacked Woodpecker, *Dinopium benghalense* (Linnaeus);Redvented Bulbul, *Pycnonotus cafer* (Linnaeus); purple Sunbird, *Nectarinia asiatica* (Latham); Hoope, *Upupa epops* (Linn) ; white-cheeked Bulbul, *Pycnonotus leucogenys* (Gray); golden *Oriole*, *Oriolus oriolus* (Linnaeus); Koel, *Eudynamys scolopacea* (Linnaeus); Pied crested cuckoo, Clamator *Jacobinus serratus* (Syarrman); Crowpneasant oi coucal, *Centropus sinensis* (Stephens); Red munia, *Estrilda amandava* (Linnaeus), etc.

The national bird of India, the common Peafowl, *Pavo cristatus* (Linnaeus) is quite common and is seen in orchards, fields and gardens of the district.

During winter one can notice birds like green plover, *Vanellus vanellus* (Linnaeus); Wagtails, *Motaoilla flava* (Linnaeus), *Motacilla Citrla* pallas, *Motacilla alba* Linnaeus), etc.

Birds of Economic Importance.—Scavengers like Pariah Kite, *Milvus migrans* (Boddaert); White-backed Vulture, *Gyps bengalensis* (Gmelin); Black vulture, *Torgos calvus* (Scopoli); Tawny Eagle *Aquila rapax* (Temminck); House Crow, *Corvus splendens* (Vieillot) etc. keep the district cleared of dead animals by feeding on them. The Egyptian or Scavenger vulture, *Neophron percnopterus* (Linnaeus); besides feeding on dead animals, consumes a large quantity of human excreta. Predators like Black winged Kite, *Elanus caeruleus* (Desfontaines); shikra, *Accipiter badius* (Gmelin); Lagger *Falcon*, *Falco biarmicus* (Temminck); Peregrine Falcon, *Falco peregrinus* Tunstall; Kestrel, *Falco tinnunculus* (Linnaeus); Spotted Owlet, *Athene brama* (Temminck); Eagle owl, *Bubo bubo* (Linnaeus), etc. keep a check on the population of not only rodent pests but also various insects by consuming them.

The challenge of insect pests is also met with by various insect eating birds, both resident and migratory. Swifts (Apodidae), Swallows (Hirundinidae); Drongos (Dicruridae); Babblers, Warblers, Fly-catchers Muscicapidae) of various species consume insects as their staple diet. Larks (Alaudidae) and Wagtails (Motacillidae) feed on a considerable amount of worms in addition to insects. Rosy Pastor and common starling, both winter visitors, and seversal species of Mynas (Sturnidae) may specially be mentioned for their role in destroying numerous injurious insects including locusts on a large scale and thus helping in saving crops to some extent.

Reptiles.—The reptilian fauna of the area comprises snakes, lizards, etc. The details are given below :—

I. Shakes

(a) Poisonous snakes.—*Bungarus caeruleus* (Schneider, the common *Krait* or *Karayat* grows to about 1.75 metre in length. The males are longer than the females. It is blue in colour with about 40 thin whitish cross bands on its body. The young ones and sometimes adults may have white spots along the first third of the dorsal side of the body in place of bands. Such snakes are nocturnal in nature and mostly found in rodent holes or piles of bricks. Its venom is extremely toxic and induces nerve paralysis.

Naja naja naja (Linnaeus).—It is a spectacled Indian cobra or Nag. It grows to about 2 metres in length. The males are longer. Its colour varies from dark brown to black with white or yellowish under sun-face. The hood is generally marked with a connected chain of rings. The snake is mostly found in rice fields which have plenty of rats for food and burrows to live in. Its venom affect the nervous system leading to respiratory paralysis and cardiac failure.

(b) Non-Poisonous snakes.—*Eryx johnii* (Russell), the Red Sand Boa or Do-mu-sanp. It grows to about a metre in length. The

female is longer, about two times that of male. It is reddish-brown in colour. Its body is thick with very blunt hood and tail. The snake is nocturnal in habit and lives in sandy places, rodent burrows, etc. It mostly feeds on rats and other small snakes. *Typhlina Porrectus* Stoliczka, the Blind Snake or *Andha-sanp*, is small-sized (12-15 cm) worm-like make. It is reddish brown in colour. It lives under the logs, moist leaves, humus and in ant and termite holes. It comes out only at night and feeds on worms, insects larvae, eggs of ants and termites, etc.

Lizards

1. *Hemidactylus flaviviridis* Ruppell.—The Indian House-Geeko or *Chipkli* :It is greenish-grey with some transverse bands. It changes its colouration very rapidly according to the habitat in which it lives.

2. *Calotes versicolor* (Daudin), the Blood Sucker or *girgit*.—It is often, but erroneously, called the chameleon. It is commonly found in gardens, around the bushes and hedges. It feeds on insects, spiders, etc. During the breeding season, the male assumes a brilliant crimson or scarlet colour.

Tortoise

Geoclemys hamiltoni (Gray).The common Kachua.—Its shell is dark brown or black, marked with yellowish spots and streaks. It is carnivorous in its food habits.

Amphibians

The amphibian fauna of the district comprises mainly of frogs and toads. The details are as follows :—

Frogs.—*Rana cyanophlyctis* (Schneider), the Skipping frog, *Rana Limnocharis* (boil), the paddy field frog and *Rana tigerina* (Daudin) the bull frog are commonly found. The Skipping frog is the commonest frog of the area and as the name implies, it can be seen skipping over the surface of water. The paddy field frog is the second commonest frog of the area. It frequents the edges of the ponds, ditches and marshes and leaps into the water when disturbed and rapidly swims ashore again. It cannot skip on the surface of water as skipping frog does.

Toad.—*Bufo melanostictus* (Schneider) is a common toad of the area. It mostly hides itself under the stones, bricks or crevices.

Fishes

The important fishes of the district are as follows :—

Scientific Name	Local name
Family notopteiidol (Pearber backs)	
1. *Notopterus chitala* (Hamilton)	*Parri*
2. *N.*notopterus (Pallas)	*Parri*
Family Cyprinidae (Tne Carps)	
3. *Catla catla* (Hamilton)	*Katla, Theil*
4. *Labeo calbasu* (Hamilton)	*Kalabans, Dhai*
5. *L. rohita* (Hamilton)	Rohu
6. *L. Pangusia* (Hamilton)	*Akhrot*
7. *Puntius sarana sarana* (Hamilton)	*Puthia, Chiddu*
Family Bagridae (Catfishes)	
8. *Aorichthys seenghala* (Syes)	*Sanghara, Singhara*
9. *Mystus vittatus* (Bloch)	*Tinger, Kinger kala-Kendar*
10. *Rita rita* (Hamilton)	*Khagga*
Family Heteropneustidae (Catfishes)	
11. *Heteropneustes fossilis* (Bloch)	*Lakhi, Sangi*
Family Schilbeidae (Catfishes)	
12. *Clupisoma garva* (Hamilton)	*Bachwar*
13. *Silonia silondia* (Hamilton)	*Siond*
Family Siluridae (Catfishes)	
14. *Wallago attu* (Schneider)	*Mullee*
Family Sisoridae (Catfishes)	
15. *Bagarius varrelli* (Sykes)	*Geonch, Retha*
Family Channidae thurrels)	
16. *Channa gaehua* (Hamilton)	*Dolla*
17. *C.marulius* (Hamilton)	*Sol, Chottisol*
18. *C.punctatus* (Bloch)	*Damra, Dolla.*
19. *C.striatus* (Bloch)	*Curd karrar*

Family mugilidae (the mullets)

20. *Rhinomugil Corsula* (Hamilton) Hurdwabra

Majority of the fishes listed above are well-known in the area. The fishes like *Cirrhinus mrigala. Labeo rohita, Catla catla, Puntius sarana sarana, Channa marulius* are good for culture. A proper development and management of the fishery resources of the district can enhance the trade for meeting the need of atleast of the neighbouring areas.

There is no game sanctuary in the district. However, a bird sanctuary is being established at Barwasni *Jheel* where 112 bird species are found in the winter.

Partridge is the State bird and the black buck is State animal of Haryana. No body is allowed to kill them. The wolves have almost become extinct in the area.

A dozen people die every year due to the cobra bite. However, the Haryana government has put a ban on destroying the Cobra under Wild Life Protection Act, 1972.

Climate

The climate of the district is dry with an intensely hot summer and a cold winter. Only during the three monsoon months,i.e. July, August and September, weather is comparatively milder due to penetration of moist air of oceanic origin in this district. The year may be divided into four sesons.

The winter season starts by late November and extends to about the middle of March. This is followed by hot season which continues to about the end of June when the South-West monsoon arrives over the district. July to September is the south-west monsoon season. The post monsoon months October and November, constitute a transition period from the monsoon to winter conditions.

Temperature.—There is no meteorological observatory in the district. Therefore, the description that follows is based on the records of observatories in the neighbouring district. Both day and night temperatures begin to fall down during the later half of November. January is the coldest month when the mean daily maximum temperature is about 21°C and mean daily minimum abour 7°C . In the winter months, during cold waves which affect the district in the wake of western disturbances passing across north India, minimum temperature may sometimes go down to the freezing point of water and frost may occur. From about the middle of March, temperatures begin to rise rapidly. May and June are the hottest months.

From April the hot westerly winds locally known as '*Lu*' blow and heat is intense. In May and June maximum temperatures may sometimes reach about 47°C. With advance of the South-West monsoon towards the end of June, day temperature drops appreciably while night temperature continues to be as nigh as in the summer. Even during the brief south-west monsoon, the weather is stuffy and uncomfortable in between spells of rain on account of the increased moisture in the air. In October, the day temperature is as high as during the monsoon months but the nights are cooler.

Humidity.—The air is dry during the greater part of the year. In the monsoon months, the humidity is high about 70% . April and May are usually the driest months, humidity in the afternoons being less than 20 per cent.

Cloudiness.—During the monsoon particularly in July and August, the skies are heavily clouded. In the rest of the year, the skies are generally clear or lightly clouded. In January, February and early March, the skies become cloudly and sometimes over cast in association with passage of western disturbances.

Winds.—Winds are generally light during the post-monsoon and winter months. They strengthen a little during the summer and monsoon months. Winds are predominantly easterly or south-easterly in the monsoon season. They are mostly westerly or north-westerly during the mornings and blow from directions between north-westerly and north-wasterly during afternoons.

Special Weather Phenomena.—April to June is the period with the highest incidence of thunder-storms and duststorms. Violent squalls (*andhis*) often accompany such storms, while some of the thunderstorms are dry and others are accompanied by heavy rain and occasionally hail. Rain during the monsoon months is often accompanied by thunder. Thunderstorms also occur in the winter months in associations with western disturbances. Fogs, sometimes dense, occur in the winter months in the rear of the western disturbances.

This is a new district formed out of Rohtak district. Records of rainfall in the district are available for 2 stations (Gohana and Sonipat) for period of abour 74 years. The details of rainfall at these stations and for the district as a whole are given in the Table I of Appendix.

The average annual rainfall in the district is 567.0mm. The rainfall generally increases from the south-west to the north-west in the district. The rainfall in the south-west monsoon season constitutes about 77 per cent of the annual rainfall, July being the month with the highest rainfall. The

annual rainfall in the district varies over a wide range. In the 80-years periods (1901-1980), the highest annual rainfall was in 1964 when it amounted to 232 per cent of the normal. In the two consecutive years 1938 and 1939 the annual rainfall in the district was the lowest in the 80-year period and was only 42 and 43 per cent of the normal rainfall in each of the two years. In the same eighty-year period, the rainfall was less than or equal to 80% of the normal in 18 years. Considering the district as a whole there was one occasion each of two (1928-29), three (1901-03) and four (1938-41) consecutive years of such low rainfall. It will be seen from the Table IA of Appendix that annual rainfall was between 401 to 700 mm. in 46 years out of 71 years.

On an average there are 30 rainy days (i.e. days with rainfall of 2.5 mm. or more) in a year in the district.

The heaviest rainfall recorded in 24 hours at Sonipat station in the district was 257.8mm. on September 19, 1933.

TOPOGRAPHY

The Sonipat district occupies a part of the Indo-Gangetic alluvial tract. The alluvium was deposited in the Quaternary Period. Therefore, it is geologically young, and so is the topographic expression developed on the alluvial terrain. The Indo- Gangetic alluvium is a major geological sedimentary basin and topographic division of India. The alluvium was deposited in a tectonic platform depression between the peninsular and extra-peninsular regions of India. In geological literature, this depression on a regional scale is known as 'geosyncline', a 'foredeep' a'syneclise', or a'crustal structure of a negative character'. The thickness variation of alluvial cover is said to be determined by the subsurface extension of tectonic lineaments of the peninsular rocks into the Indo-Gangetic Plain. These buried basement features are also reflected in the surface configuration and geohydrologic characteristics of the overlying alluvial terrain.

On the basis of geophysical and other data, the geologists have inferred[1] that a large basement high of peninsular rocks is buried beneath a variable, yet of an enormous thickness of alluvium in the area between the Jamuna of the Ganga system, and the rivers of the Punjab draining into the Indus river. The thickness of alluvial cover over the basement rocks is not precisely known, but it may be any where up to 2 km thick at many places. The tectonic map of India published by the Oil and Natural Gas Commission in 1968, and subsequently discussed by many geologists for the subsurface straigraphy and geological evolution of the eastern section of the Indo-Gangetic Plain or the

1. Rao, M.B.R. (1973). The subsurface geology of the Indo-Gangetic Plain. J. Geol. SOC. In 14(3), 217—242.

'Ganga Basin' suggests that two subsurface faults traverse through the Sonipat district in a roughly north-east-south-west direction. Further, a subsurface geological structure demarcating the western margins of the 'Ganga Basin'[1] and referred to as 'Delhi-Hardwar Ridge', has also been identified in the eastern parts of the Sonipat district. The subsurface ridge is not very conspicuous in the district as it is reportedly shallow in character and overlain by any enormous thickness of alluvial cover. However, the geomorphic implications of such geological structures in the evolution of drainage and topography are not understood in clear terms at the present time.

Geologists conveniently classify the Indo-Gangetic alluvium into 'newer' alluvium or *'khadar'* and 'older' alluvium or *bhangar*[2] These basic divisions of the alluvium not only reflect the geomorphic events or processes, but also the characteristic topograhies associated with each type of alluvium.

The part of the alluvium that has been extensively reworked by the fluvial activity in the Recent is the newer alluvium or the *khadar*. The topography of this surface is expressed by numerous buried channels, palaeochannels, oxbow lakes, meander scrolls and point bars. The *khadar* is reportedly rich in detrital minerals like garnet and mica, and heavier lag deposits in abandoned channels. In fact, these features represent the areas of present, active floodplain, and the past floodplain of the river traversing through the pre-existing alluvial tract. The *bhangar* or the older Pleistocene alluvium occupies the higher topographic portions of the Indo-Gangetic alluvium not affected by the fluvial activity so well characteristic of the *khadar*. Therefore, the *bhangar* tract makes the highest terrace.[3] The *bhanger* is generally distinguishable from the *khadar* in terms of the presence of salt afflorescences known as *reh* or *kallar*. These concretions and salt encrustractions are evaporites formed by the evaporations or soil capillary and stagnant waters during periods of high thermal efficiency in the dry periods. These salts are termed as calchie and are rich in carbonates, sulphates and chlorides of sodium, calcium and magnesium. In Sonipat district, calchie has been observed in the Recent alluvium also. Thus, a classification of alluvium into *khadar* and *bhangar* on the basis of salt afflorescences may not hold for the district under reference. Therefore, the geomorphic observations of reworked alluvium is the only suitable criterions for distinguishing the two surfaces which otherwise differ only slightly in other details. The sediment data from the adjacent Union Territroy

1. Sastri, V.V., L.L. Bhandari, A.T.R. Raju and A. K. Dutta (1971), Tectonic framework and subsurface stratigraphy of the Ganga Basin. *J. Geol. Soc. Ind.*, 12 (3) 222—233.
2. Pascoe, E.H. (1950), *Manual of the Geology of India and Burma*, Vol. 3, 3rd Edn., Govt. of India Press, Calcutta.
3. Sharma, V.K. (1986), Geomorphic criteria in land classification. In A.B. Mukerji and A. Ahmad (Eds) *India-Culture, Society and Economy*, Inter-India Publications, New Delhi, pp 601-608

of Delhi suggests that the *khadar* of the Jamuna river overlies sands of aeolian environment.[1] Here, the aeolian sands directly overlie the bedrock, which suggests that the river deposited sediments came into existence only after the sands of aeolian province were laid-down. Borehole stratigraphic data to supplement this observation are not available for the Sonipat district, but it may be cautiously inferred that almost similar geological conditions may also have prevailed in the district.

On the basis of geomorphic evolution, three geological environments and consequently related topographies have been recognised in the Sonipat district. These, from east to west are : (1) the active, Recent floodplain of the Jamuna river, (2) the sub-Recent floodplain, and (3) the Pleistocene upland or the *bhangar*. The topographic details of the three regions are as folows :—

The active, Recent floodplain.—This geomorphic unit extends along the western bank of the Jamuna river in a north-south direction. Taking the first major break of slope west of Jamuna river, the boundary and the morphological features of the active floodplain have been identified and delimited on aerial photographs of 1969. The active floodplain may be defined as a tract of land adjacent to the river that is liable to flooding once in 2-3 years. A comparison of the position of the Jamuna river given in the survey of India topographical maps surveyed in 1974-77 and that obtained from aerial photographs also provides useful preliminary assessment of the evolution of the active floodplain. The western limit of the active flood plain may be roughly described as extending in north to south direction from near east of Chandauli and Pabnera, along the Pabnera and Tikola bandhs and Garhi, east of Machhraula, along Nand aur and Barauli, east of Mirakpur and Jajjal roughly criss-crpssing Jhundpur Khatkar bandh, up to Khurrampur, east of Baquipur and thorugh Khatkar and Dahesra villages. It is a tract of irregular, up to a maximum of 3 km width in east-west direction. The floodplain comprises two major topographic divisions as splays and overflow channels.

The splays comprise localised concentration of overbank sediments adjacent to the river bank. These sediments make longitudinal bars comprising finer sand ractions and are evolved when floods find passage through topographic lows, principally of pre existing river courses. The resulting topography is that of low undulating relief. Two such splays have been identified in the Sonipat district. In one instance, such topography extends for

(1) Srivastava, A.K., P.M. Jalota, G. Ghosh, S. Anantharaman and A.K. Singh (1976), A reveiw of geotechnical studies and its application in environmental management of Delhi. In *Qtaternary : Recent Geological Enironments and Environmental Management* Vol. III, 125th Anniversary Celebrations, Geol. Surv. Ind. (memo).

about 5 km. from the boundary of the district with the Jamuna river tothe east of Pabnera village. The elevation in this case is about 220 m. In the second case, the splays roughly terminate at the Drain No. 8. These deposits occur at an elevation of about 213 m. and span a distance of about 7 km.

The topography due to overflow channels is identified east ofTikola Bandh. Here these longitudinal ridges of coarse sandy bedload of low relief with shallow broad intervening depressions cover a ditance of some 8 km.

Lateral migration of the channel of the Jamuna river as observed on aerial photpgraphs and topographical maps suggest that the river has a general tendency to enlarge meander loops, shifting perceptably towards Uttar Pradesh. The river appears to have shifted its course locally eastward to a distance of roughly 2 km in 7 years. The westward lateral shifting of the river into the Sonipat district is slight during which process it has destroyed and rebuilt the deposits, such as splays and overbank channels.

The Sub-Recent Floodplain.—The sub-Recent floodplain or the Jamuna *khadar* constitutes a major part of the topography of the Sonipat district. It is morpholigically segmented into the features of point bar accumulation and meander scrolls. The point bars are made of alternating series of arcuate to linear ridges of stratified sand to mud-sized amaterial deposited at the outside bend of meandering channels. The intervening depressions or swales are accumulation of finer sediments from overflows. In most cases, these swales provide favourable conditions for waterlogging. In essence, each point bar represents migration of the channel during floods. The meander scroll topography results from abandoning of channels through short meandering loops of laterlly shifting channels on the floodplain or the surface of the older alluvium. In such a process of migration, complexly interlaced network of abandoned channels is produced. Consequently, the meander scroll topography displays large micro-variations in slope and relief properties of the floodplain.

Between the irregular boundary of the Recent floodplain and some 6 km to the west of the National Highway No. 1 is the topography dominated by point bars and meander scrolls. From north to south, the point bar may be observed in the district around the settlements. Approximate elevation values in metres for these settlements are connected with the areas : Ghasoli, Kamashpur, Bahalgarh, Dipalpur, Kheora, Khurrampur, and Kundli. The relative relief in these areas is upto 3 metres. The swale and ridge topography is characteristic of extensive *kallar* and at places up to 90 per cent of the land is unfit for cultivation due to salt hazards, waterlogging and coarse soils. However, it is in the swales that the finegrained sediments have been extensively utilised for brick-making. At least two beautiful oxbow lakes have been observed in the point bar topography. The one fully developed oxbow lake exists to the

west of Sersa and east of Kundli on the National Highway No. 1. Further north, a silted-up, and not so well developed, oxbow lake may be noticed near Teha on the National Highway No. 1.

Numerous abandoned and buried channel segments are typical features of the meander scroll topography. In the *khadar* of the Sonipat district, such micro-relief element of the fluvial landscape cannot be discerned on the Survey of India topographical maps of the area. Occasionally, the topography due to meander necks is also a salient feature of the *khadar* terrain. Bidhal, for example, is situated on a beautiful broad meander neck to the east of Bainswal distributary. Similarly, the Pinana village to the southeast of Bidhal also occupies a position atop a meander neck. Meander neck, by defintion, is a topographic feature resulting from the process of neck cut-off in a freely meandering belt.

Some sizable abandoned channels that span the district from west to east may be referred to as near Rabhra situated to the west of Drain No. 8, north of Bidhlan and near Bhagan, between the north of Mahlana and Juan, northwest of Salimpur Torali, north of Bhadi, Dobheta and between Aanwali, and Bilbilan villages where several such small abandoned segments of palaeochannels exist. It is in these tracts of intersecting channels in short shallow loops that extensive salt afflorescences and waterlogging conditions have locally developed. These are several such instances in the district. Some palaeochannels, 4 kilometer or more in length are generally restricted to the topography dominated by point bars and meander scrolls near the Jamuna river. These may be observed between Smalkha Drain to Kheri Gujar, and beyond south of Rathdhana, between Datauli and Ghasoli, east of Rajlu, near Piplikhera, between Murthal and Nangal Khurd, from Bakhtawarpur to Mehndipur and between Basaudi and Palra. Often aggraded channels occur between Dipalpur and Jakhauli.

A few buried channel segments have also been recognised in the *khadar* tract of the Sonipat district. From east to west, these buried channels may be observed near Rathdhana, Lahrara, Bhadana, Bhatgaon and Ganwari.

The meander scroll topograohy lies approximately between 230 and 220 metres above the mean sea level. The elevation decreases towards the east and south.

Imprints left by the meandering channels across the previously existing Pleistocene upland surface viz., meander scrolls, point bars, abandoned and buried channels, and meander necks, suggest that the traditional boundary between the *khadar* and *bhangar* does not pass to the east of the Soinpat town, or long or near the National Highway no. 1. In fact, the line of separation is rather poorly defined and needs a careful delineation. As a rough approximation, the area of *bhangar* terrain does not exceed more than 10 per cent of the total area of the district, and it lies well to the west of Rathdhana and Bhawar.

The anomalously large area of the *khadar* that occupies the Sonipat district may perhaps be explained by the presence of subsurface fault, a few thousand metres beneath the alluvial cover[1]. It is possibly in response to the movements along these faults recorded by the seismic activity around Delhi that the Jamuna has been able to rapidly swing its course since the Quaternary.

The Pleistocene Upland Surface.—The *bhangar* is a topographically flat, almost expressionless surface of deep alluvial cover. In this tract, the elevations roughly vary between 230 and 235 metres above the mean sea level.

Drainage

The Jamuna river shares a common boundary of some 49 kilometres between Uttar Pradesh and Sonipat district. During this course, the river falls in elevation from 218 to 209 metres, giving it a very gentle gradient of about 1 metre per 5.44 kilometres. Nowhere in the district is the free flow of the river utilised for irrigtion or industrial usages.

Groundwater

Due to poor surface drainage on account of the nature of topography, systems of abundant palaeochannels and surface materials described above, the water table is very high. These conditions accentuate the poor surface drainage from irrigated fields. Seepage from the Jamuna river, and distributaries and field channels taking-off principally from the Bhaulat Branch are the other conditions leading to a high subsurface water level in the district. In most of the area, waterlogged and potentially waterlogged (water table within 1.52 metres from the surface) conditions are a rule than exception. It is only in few tracts bordering Delhi and Rohtak districts that the water table is up to 6 metres deep.

The Groundwater Directorate, Karnal has estimated the groundwater potential of the Sonipat district at 502 million cubic metres, of which the reservoir of fresh water alone accounts for 68 per cent of the total groundwater, available for exploitation.[2] Whereas the percentage utilisation as on 1st April 1972 was determined to be 25 per cent of the available exploitable resource, it exceeded beyond the natural recharge into the ground-water reservoir, and stood at 514 million cubic metres in 1981-82. The accent on exploitation of groundwater in the district is, thus, evident. If this trend continues in the years ahead, it will lead to over exploitation and finally to ground-water mining a practice that should not be encouraged under the existing groundwater balance conditions.

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1. Sinha, R.K. (1986), Morphotectonic evolution of the Quaternary landsystems of the middle reaches of Yamuna Basin. In *International Symposiam* on Neotectonics in South Asia, Dehra Dun, Feb. 18—21, pp. 289—300.

2. Groundwater Directorate, Karnal (1973), *Groundwater potential of Haryana* Tech. Rept. 11 5, 9 pp. (memo).