CHAPTER I

GENERAL

ORIGIN OF THE NAME OF THE DISTRICT

The Panipat *tehsil* remained a part of Karnal district up to the end of October, 1989. The Panipat district was created vide Haryana Government Notification dated 16th October, 1989[1] and came into existence on 1st November, 1989. It was abolished and merged in Karnal district on July 24, 1991, but was created again w.e.f. 1-1-92[2].

Panipat seems to derive its name from *Patas* or *Prasthas*[3]. One popular tradition avers that this is one of the five *Patas* or *Prasthas (Indraprasthas, Panipat, Talpat, Bhagpat and Sonepat)* mentioned in *Mahabharata* which Yudhishthira demanded from Duryodhana. Panipat was earlier known as *Panprastha*[4], an abode of water or a watery place. Some historians like H.A.Phadke call it a *Panikhet* which means 'abundance of water'. Also, there were some manuscripts in possession of the daughter of a learned teacher and priest of a Hindu temple where the name of town was given as *Jalaprastha*[5], instead of Panipat.

LOCATION, BOUNDARIES, AREA AND POPULATION

Location and boundaries.— The district lies between 29º 09´ 30" and 29º 30' 00" North latitude and 76º 30' 00" and 77º 11' 00" East longitude. The District is situated on Sher Shah Suri Marg (Grand Trunk Road or NH-1) and 90 kilometres from Delhi. It is situated on both sides of G.T.Road and bounded by the Karnal district on the North. To its North-West and West is Jind district. To its South-West and South is Sonepat district. The Yamuna river marks the eastern boundary of the district and touches with Uttar Pradesh across Yamuna.

Area.— With an area of 1268 square kilometres, it occupies 2.9 percent of the total area of the State. It ranks 18th in size among the 21 districts of the State.

Population.— According to 2011 census, the district had total population of 12,05,437 persons having 6,46,857 males and 5,58,580 females. It ranks population-wise tenth among the districts with 4.75 percent of the total population of the State. As per census 2011, the total population of the district, rural and urban is as under:-

Population of the District (Census 2011)

	Total Population	Male	Female
Rural	650352	349642	300710
Urban	555085	297215	257870
Total	1205437	646857	558580

HISTORY OF THE DISTRICT AS AN ADMINISTRATIVE UNIT

Panipat is a land of hoary antiquity and legendary tradition. It has been a battle field of India from the time of Mahabharta.

The district consisted of two portions with a distinct administrative history up to 1862 when the British took over the area after the Treaty of Surji Arjungaon in 1803, the portion comprising the present Panipat Tehsil and a part of the Karnal Tehsil became part of the Delhi territory. This area was expressly excluded from the purview of the Bengal Regulations. Some villages were added to Panipat from Jind in 1816. In 1819, the Delhi territory was reorganized into four parts which were the beginning of the districts of Delhi, Rohtak, Gurgaon and Hisar. The districts of Delhi, as then constituted, consisted of two *parganahs,* the 'north' and 'southern'[6]. Between them, they comprised the Delhi tehsil, the northern portion of the then Ballabgarh tehsil and a small portion then included in Rohtak district. The Sonipat tehsil, with its headquarters at Larsoli, formed the Larsoli *parganah* of the Panipat district[7]. In the remainder of the Karnal and in the Panipat tehsil, the old division into *parganahs* Panipat, Sunpat and Ganur were still followed in the Kanungo's records. In 1822, some villages of Sunpat were added to Panipat. There was originally only one *tehsil* at Panipat; but in 1823, by which date the greater part of the Jagir land had been resumed, a separate *tehsil* was formed at Barsat for the Khadar villages, the Mandal tract being excluded altogether. The Panipat District, including the area of Panipat, Karnal, Sonepat was formed as the fifth district in the re-organisation of 1824. In 1829, the Khadar *tehsil* was transferred from Barsat to Panipat, the two being distinguished as *Bangar* and *Khadar*. The Bangar villages were generally known as *parganahs* Panipat, and the *Khadar* villages indifferently as *parganahs* Barsat or Chaunsat up to 1830, from which date the two divisions were known as Panipat-*Bangar* and Panipat-*Khadar*. In 1832, Panipat district, alongwith the other four districts of Delhi, Rohtak, Gurgaon and Hisar, was included in the North-Western Province[8]. In 1835-36, the boundary between Sunpat and Panipat took its shape, when Ganaur was absorbed into Sunpat Khadar excepting some villages that were given to Panipat.

In 1841, the Rohtak district was broken up, and *parganah* Gohana was added to Panipat, but the alteration was shortly afterwards cancelled. The few villages that were held in separate *Jagir* were often called a *parganah,* though the individual villages might be miles apart; and the some villages were often quoted quite indifferently as being in one or other two different *parganahs.* In 1851, after the settlement of the Mandal villages, the territory was divided into Panipat and Karnal, with *tehsils* at Panipat and Gharaunda, respectively. In 1854, the headquarter of district were moved to Karnal. In 1858, the district, along with the other portion of the Delhi territory, lying north of the Yamuna, were transferred

from the North-West Provinces to the Punjab; and in 1862 tehsil Kaithal and *parganah* Indri were added to the district[9].

In the last three decades of the nineteenth century, and up to the independence no major change took place in the boundary of Panipat *tehsil*. After independence, between 1961 to 1969, the *tehsil* gained three villages of Uttar Pradesh due to river action.

Since the carving of the Haryana State from Punjab and up to October 1989 when it was made a separate district, Panipat was one of three *tehsils* of Karnal District. At the time of 1981 census, the Karnal district consisted of three *tehsils* viz. Karnal, Assandh and Panipat and eight towns, of which Samalkha was the only town having the status of a census town. Assandh *tehsil* was having 42 villages and one town named Assandh and Panipat *tehsil* had 185 villages and two towns- Panipat and Samalkha. Assandh and Panipat *tehsils* which later on were transferred to newly formed Panipat district in 1989, underwent subsequent changes during 1981-91 in the event of composition of the present district of Panipat as per census 1991. Assandh *tehsil* gained 2 villages from Kaithal *tehsil* of newly formed Kaithal district, 4 villages from Jind *tehsil* and 1 village from Safidon *tehsil* of Jind District and at the same time lost 3 villages to Karnal *tehsil* of Karnal District. Thus, at the time when district formed i.e. as per 1991 census Assandh *tehsil* was composed of 46 villages as against 42 villages in 1981.

In the case of Panipat *tehsil*, it gained 3 villages; 1 from Karnal *tehsil* of Karnal District and 2 from Sonipat *tehsil* of Sonipat District. As a consequence of these transfers, Panipat *tehsil* increased its strength of villages from 185 in 1981 to 188 in 1991 census[10].

The position of Panipat district on the eve of 1991 census was as under:-

Name of tehsil	No. of Villages	Name of town
Assandh	46	Assandh (M.C.)
Panipat	186 {	Panipat (M.C.) Samalkha (M.C.)

Samalkha (M.C.) was upgraded to the status of a Municipal committee from its civic status of a census town in 1981 and two villages (revenue estates) were fully merged in Panipat town.

The Panipat district was abolished and merged in the mother district of Karnal on 24th July, 1991. It was again formed as a district by Haryana Government notification dated 31st December, 1991[11] with the merger of eighteen revenue estates and three exclusions from Karnal, Assandh and Gharaunda Sub-tehsils.

The position of the Panipat District on January 1, 1992 was as under:-

Tehsil	Name of Kanungo Circle	No. of Villages	Sub Tehsil
Panipat	Panipat	52	--
	Madlanda I	23	Madlauda
	Madlanda II	13	-do-
Samalkha	Samalkha I	17	--
	Samalkha II	16	--
	Bapoli	49	Bapoli
Israna	Israna I	14	--
	Israna II	14	--
Total	8	198	2

Panipat tehsil gained 9 villages from Karnal tehsil and one village from Assandh tehsil whereas it lost 118 villages to two newly created tehsils of Samalkha (82 villages and Samalkha town) in December, 1991and Israna (36 villages) in March, 1996 during reorganization of the district. Assandh tehsil with 42 villages and the town was transferred to Karnal district in July, 1991. According to the 2001 Census, the district contained three tehsils, namely, Panipat (74 villages and five towns of Panipat MC and four Census Towns, namely, Taraf Rajputan, Taraf Ansar, Taraf Makhdum Zadgan and Asan Khrud), Israna (36 villages and no urban area) and Samalkha (82 villages and Samalkha town)[12]. The jurisdiction changes in the district area during the period of 1991-2011 are given below:-

Jurisdictional Changes 1991-2011, District Panipat

Name of District / Tehsil	Number of Villages			Number of census towns		
	1991	**2001**	**2011**	**1991**	**2001**	**2011**
District Panipat	232	192	186	3	6	12
Tehsil Panipat	186	74	76	2	5	11
Tehsil Israna	-	36	28	-	-	-
Tehsil Samalkha	-	82	82	-	1	1

According to the 2011 Census, the district contains three tehsils, namely, Panipat (76 villages, Panipat city MC and ten Census Towns), Israna (28 villages and no urban area) and Samalkha (82 villages and Samalkha town). There were 186 villages including 10 uninhabited villages in the district as on March 31, 2011. The tehsil-wise details are as under:-

Tehsil	**Villages**		
	Inhabited	Un-inhabited	Total
Panipat	75	1	76
Israna	27	1	28
Samalkha	74	8	82
Total	176	10	186

GEOLOGY

The district is covered by loose to semi consolidated quaternary sediments, which forms the part of Indo-Gangetic plain and has been divided as Older Alluvium and Newer Alluvium. The area is more or less flat and has master slope from North to South. The age of the sediment varies from Middle Pleistocene to Holocene. The details of geology in this area are given below:-

The Older Alluvium.— Older Alluvium (Middle to Late Pleistocene age) occurs at relatively higher level and comprises poly cyclic sequence (+460m thick) of micaceous sand, silt and clay with calcareous *Kankar* at places. The colour of the sediment varies from dirty yellow to pale yellow due to oxidation. *Kankar* occurs both in pedogenic as well as non-pedogenic form.

The Newer Alluvium.— Newer Alluvium (Holocene age) confine to Yamuna river domain as flood plains of Yamuna at relatively lower of older Alluvium. It includes older flood plains (T_1 terrace) and active flood plains (T_0) deposits and comprises of grey to light buff coloured micaceous sand, silt and clay with pebbles of quartzite, limestone, reworked conglomerate, phyllites and basic rocks. Older flood plains represent erosional and depositional terraces and shows abandoned channels and meander scrolls. Active flood plain is restricted to present bank of Yamuna river channel in the form of channel bars/point bars and gets modified by annual flooding.

Economic Minerals.— The following minor and building material are recovered from Panipat District:-

Sand.- It occurs in abundance at *Barsat* and is being used in concrete mixture for construction.

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

Kallar/reh.- The material is used for washing clothes by local washer men.

FLORA

The larger part of the district falls under semi arid zone marked by high temperature, in summer and acute moisture deficiency due to high evapo-transpiration and low rainfall. The surplus moisture occurs in July-August during rains. The soil generally consists of Indo-Gangetic alluvium with beds of sedimentary rocks and is slightly alkaline in nature. These climatic factors support chiefly tropical dry deciduous vegetation in the district. In general, there is a mixed growth of various trees, shrubs and herbs species found in the different localities with botanical names, local names and families, details of which are given in the Table-I of Appendix.

Aquatic Flora.— Certain seasonal water bodies in the districts include ponds, lakes and canals. The submerged hydrophytes include species of *Ceratophyllum, Hydrilla, Najas, Potamogeton, Valliseneria, Nymphaea, Trapa etc.* The other aquatic species are *lpomea reptans, Marsilea minuta, Azolla pinnata, Eichornia crassipes, Wolfia microscopica* etc.

Medicinal Plants.— Various invaluable medicinal plants used in Ayurvedic, Homeopathic and Unani medicine system are found in the district. Certain important species are mentioned here *Abrus precatorius, Abutilon indicum , Acacia catechu, Acanthospermum hispidum, Achyranthes aspera, Ageratum conyzoides, Amaranthus spinosus, Andrographis paniculata, Calotropis gigantean, Calotropis procera , Clerodendrum serratum , Eclipta prostrate, Euphorbia hirta, Martynia annua, Moringa oleifera, Sida acuta, Sida cordata, Syzygium cumin, Centella asiatica* (Brahmi), *Cassia fistula (Amaltas), Cassia occientalis, Cassia tora, Ocimum basilicum* (Tulsi), *Withania somenifera* (Asvagandha), Mentha spp., *Argemone mexicana* (Satyanashi), *Boerhavia diffusa)* (Punarnava), *Vitex Negundo* (nirgundi), *Solanum spp., Oxalis corniculata* (Bicchu Buti), *Azarirachta indica* (Neem), *Jasminum* spp. *Leucas* sp. *Terminalia* spp. etc.

Timber Yielding Plants.— Some important timber yielding plant species in the district are *Tectona grandis* (teak), *Populus nigra* (Popular), *Michalia champaca, Dalbergia sissoo* (Sesum), *Acacia* spp. *etc.*

Grasses.— Grasses have a fair scope in the district. Various species are used by locals for various domestic purposes like fibre, fodder, thatching material, etc. Some of these are *Saccharum munja* (Sarkanda), *Alopecurus nepalensis, Cenchrus sentigery, Cynadon dactylon* (Dub), *Eragrostis* spp., *Zizanoides* sp. (Khas-Khas), *Setaria verticellata, Sporobolus iocladres, Eragrostis japonica, Echinochloa crusgalli, Desmostachya bipinnata, Cymbopogon* sp., *Apluda mutica, Scripus maritimus* etc. Certain agriculture weeds are *Setaria glauca, Saccharum Bengalese, Eragrostis cilianensis, E. tenulla, Sporbnolus* spp., etc.

Weeds.— Some common weeds found in the district viz., *Acacia farnesiana, Aerva javanica, Alternanthera pungens, Alternanthera sessilis, Amaranthus spinosus, Bidens pilosa, Blumea lacera, Celosia argentea, Chloris barbata, Conyza Canadensis, Corchorus olitorius, Crotalaria retusa, Croton bonplandianum, Cuscuta reflexa, Cyperus difformis, Echinochloa crusgalli, Eichhornia crassipes, Euphorbia heterophylla, Hyptis suaveolens, Lantana camara, Leonotis nepetifolia, Parthenium hysterophorus, Portulaca oleracea, Prosopis juliflora, Tridax procumbens,* etc.

FAUNA

The common fauna known from Panipat district belong to the both the major groups i.e. vertebrates (animals with vertebral column) and invertebrates (animals without vertebral column).

VERTEBRATES

All five classes of the vertebrates i.e. mammals, birds, reptiles, amphibians and fishes are known to occur in district descriptions of which are given in the following paragraphs.

MAMMALS

The larger mammals include one species of primate: Rehsus Macaque or Bandar *(Macaca mulatta)*; three species of carnivores: Small Indian Civet *(Viverricula indica)*; Grey Mongoose *(Herpestes edwardsii)*; and Jackal *(canis aureus)*, and another three species of herbivores: Wild Boar or Jungli Suar *(Sus scrofa)*; Black Buck *(Antilope Cervicapra)* and Blue Bull or Nilgai *(Boselaphus tragocamelus)*.

While the smaller mammals of the district Panipat include four species of rodents: House Mouse *(Mus musculus)*; Common House Rat *(Rattus rattus)*; Indian Gerbil *(Tatera indica)*; Five-stripped Palm Squirrel *(Gunambulus pennantii)*; three species of bats: Indian Flying Fox *(Pteropus giganteus)*; Common Pipistrelle *(Pipistrellus pipistrellus)*; and Indian Pipistrelle *(Pipistrellus coromandra)* and one species of Lagomorpha: Indian Hare *(Lepus nigicollis).*

BIRDS

Due to their flying ability, beautiful colours, worldwide occurrence, diurnal habits, socio-economic importance, along with the wealth of data available and the resultant ever increasing awareness about the role of birds which they play in the maintenance of natural ecosystem, environment and also in understanding of the climate change, etc., a constant need is being felt to know the avifauna of a given area.

Out of more than 400 species of birds known from the State of Haryana, the following common birds are known to occur in Panipat district. For convenience, the avian community of the district can broadly be summarized in to following main groups: Water birds, Game birds, Scavenger and Predator birds, and Colourful birds.

(a) Water birds.— The ducks visiting the district during winter are: Brahminy Duck (*Tadorna Ferruginea*), Northern Pintail (*Anas acuta*),

Common Teal (*Anas Crecca*), Mallard (*Anas platrychos*), Gadwall (*Anas Strepera*), Wigeon (*Anas Penelope*), Northern Shoveller (*Anas clypeata*), Common Pochard (*Aythya ferina*), etc. The resident wetland birds being: Spot-billed Duck (*Anas poecilorhyncha*), Little Grebe (*Tachybaptus ruficollis*), Little Cormorant (*Phalacrocorax niger*), Large Cormorant (*Phalacrocorax carbo*), Little Egret (*Egretta garzetta*), Cattle Egret (*Burbuclus ibis*), Indian Pond-Heron (*Ardeolla grayii*), Black-crowned Night-Heron (*Nycticorax nycticorax*), Grey Heron (*Ardea cinera*), Indian Moorhen (*Gallinula chloropus*), Purple Moorhen (*Porphyrio porphyrio*), Black-winged Stilt (*Himantopus himantopus*), Red wattled Lapwing (*Vanellus indicus*), White-breasted Waterhen (*Amaurornis phoenicurus*) etc. The lanky birds are Painted Stork *(Mycteria leucocephala)* (listed as Near Threatened IUCN 2010), Asian Openbill *(Anastomus oscitans)*, Black-necked Stork *(Ephippiorhynchus asiaticus)*, Glossy Ibis *(Plegadis facinellus)*. The common waders, namely, Greenshank *(Tringa nebularia)*, Common Sandpiper *(Tringa hypoleucos)*, etc are also found.

(b) Game Birds.— The common among these are: Black Francolin (Kala Teetar, in Hindi) *Francolinus francolinus* ; Grey Francolin (Bhura Teetar) *Francolinus pondicerianus* ; Indian Peafowl (Mor) *Pavo cristatus* ; Quails (Common, Rain, etc.); Yellow-legged Green-Pigeon (Hariyal) *Treron phoneicoptera* ; Blue Rock Pigeon (Kabutar) *Columba livia* ; Little Brown Dove (*Streptopelia senegalensis)* and Eurasian Collared-Dove (*Streptopelia decaocto)*.

(c) Scavenger and Predator Birds.— The common scavengers are: Black Kite (*Milvus migrans*), Egyptain Vulture (*Neophron percnopterus*), Indian White-backed Vulture (*Gyps bengalensis*), House Crow (*Corvus splendens*), etc. Like all the other vultures, due to drastic decline in populations of Egyptain and White-backed both these vultures have recently been listed as Endangered and Critical, respectively, by the IUCN (2010).

Predator birds like Black-shouldered Kite (*Elanus careuleus*), Tawny Eagle (*Aquila rapax*), Short-toed Snake-Eagle (*Circaetus gallicus*), Shikra (*Accipiter badius*), along with the Kestrel (*Falco tinnunculus*), and Spotted owlet (*Athene brama*), etc. keep a check on the populations of their prey species like rodent and insect pests.

(d) Colourful Birds.— The commonly seen colourful birds are: Indian Peafowl (*Pavo cristatus*)-the National Bird of India, Indian Roller-Neelkanth (*Coracias benghalensis*), Common Hoopoe (*Upupa epops*), Small Bee-eater (*Merops orientalis*), Brown-headed Barbet (*Megalaima Zeylanica*), Coppersmith Barbet (*Megalaima haemacephala*), Eurasian Golden Oriole (*Oriolus oriolus*), Rose-ringed Parakeet (*Psittacula*

Krameri), Keol (*Eudynamys scolopacea*), Kingfishers such as Common Kingfisher (*Alcedo atthis*), White-breasted Kingfisher (*Halcyon smynrensis*), Red-vented Bulbul (*Pycnonotus cafer*), Purple Sunbird (*Nectarinia asiatica*), etc.

(e) Other common birds.— Other common birds are House Sparrow (*Passer Domesticus*), Oriental Magpie-Robin (*Copsychus saularis*), Indian Robin (*Saxicolides fulicata*), Pied Bushchat (*Saxicola caprata*), Indian Chat (*Cercomela fusca*), Common Babbler (*Turdoides caudatus*), Jungle Babbler (*Turdoides striatus*), Plain Prinia (*Prinia Inornata*), Common Tailorbird (*Orthotomus sutorius*), Black Drongo (*Dicrurus macrocerus*), Brahminy Starling (*Sturnus pagodarum*), Rosy Starling (*Sturnus roseus*), Asian Pied Starling (*Sturnus contra*), Common Myna (*Acridotheres tristis*), Bank Myna (*Acridotheres ginginianus*), Baya Weaver (*Ploceus philippinus*), House Swift (*Apus affinis*) etc.

REPTILES

The reptilian fauna of the area comprises snakes, lizards and turtles.

A. SNAKES

(1) NON-POISONOUS SNAKES

(i) Common Blind Snake or Brahminy Worm Snake (*Ramphotyphlops braminus*).—Adult average length: 125 mm (5 inch); maximum length 250 mm (9 inch). Tiny scale covering eye is visible as black dot, short, blunt tail ends in a tiny spine. The body is glossy, uniform, reddish-brown or blackish-brown above; lighter below. Often mistaken for a worm, but close look will reveal the scale, eyes and tiny tongue. Only upper jaw (maxilla) has teeth. It is one of the few known parthenogenetic (or self-fertilizing) snakes.

(ii) Indian Python or Rock Python (*Python molurus*).— Adult average length 3000 mm (118 inch); maximum length 7620 mm (300 inch). The species is thick bodied, smooth-scaled. Head broader than neck; eye has vertical pupil. First two upper lip scales have heat sensitive pits. Upper surface of head has large scales of different shapes and sizes. The body has yellowish to brown with asymmetrical dark brown, black edged blotches. Tip of arrowhead mark on head indistinct in adults; tongue and parts of head pale pink. Two dark streaks on side of head-one below, the other through behind eye. Underside is white or yellowish. This species is killed for its skin demand in the market. **Status**: Rare, IW(P)Act 1972: Schedule I;IUCN: NT (2011); CITES: Appendix I

(iii) Red Sand Boa or John's Sand Boa (*Eryx johni*) .— Adult average length 750mm (30 inch); maximum length 1000mm (39 inch). The species is common. The head is with a wide, shovel-shaped scale at the snout. Head is not broader than neck. The tail is blunt resembles the head, thus, giving the mis-belief that it has two heads. Eye is with vertical pupil. The colour varies from reddish brown, dark brown, speckled grey, yellow or black. Belly is white spotted with brown or sometimes entirely brown. The tail is sometimes banded with black bands.

(iv) Indian Rat Snake or Dhaman (*Ptyas mucosus*) .— Maximum length 3500 mm (138 inch). Scale smooth or keeled (upper rows). Head broader than neck. Large eye has round pupil. The colour varies from pale yellow, olive brown, gray or black. Body lightly or strongly marked with black; markings usually distinct on tail. Lip scales usually separated by vertical black lines. Underside often has prominent dark crossbars. Large rat snakes can inflict painful (though harmless) bites, but calm down with gentle handling.

(v) Checkered Keelback (*Xenochrophis piscator*) .— Maximum length 175mm (69 inch). Scales are keeled. Head broader than neck. Eye has round pupil. Two bold black streaks-one below, the other from eye to angle of mouth. Colour varies from glossy olive green, olive brown, yellow, brown, gray or black, usually with a checkered body pattern. In between checks sometimes there are present varying shades of pink or red. Underside is glossy white or yellowish white. During rains, these are often killed on roads probably due to their diurnal habits. **Status:** Common. IW(P)Act 1972, Schedule II

(2) POISONOUS SNAKES

(i) Common Indian Krait (*Bungarus caeruleus*) .— Adult average length 1000mm (39 inch); maximum length 1750 (69inch). The body colour varies from a dark steely blue black to a pale faded bluish grey with narrow (sometimes paired) white cross–lines that continue to pointed tip of short tail. These lines usually absent on fore-body or they are replaced by white vertebral spots. Eats snakes (even other Kraits), sometimes eats rodents, lizards, and frogs.

(ii)Spectacled Cobra (*Naja naja*) .— Adults length 1000 mm (39inch); maximum 2200 mm (87inch). In India, the spectacled cobra is much respected and feared, and even has its own place in Hindu mythology as a powerful deity. Head broad. Color, pattern, and hood mark variable and hood mark is sometimes absent. It is found in various shades of brown, yellow, gray or black, often with a speckled, sometimes banded

pattern. The scales all over body are smooth and glossy. The "spectacled" marking (or variations) on hood is a major characteristic of the species. The body is dark or black and pattern less Spectacled Cobra are frequently mistaken for the Central Asian Cobra. It has been found that cardiotoxin of the Indian cobra (*Naja naja*) is a pyrophosphatase. **Status:** IW(P)Act, Schedule II.

(iii) Russell's Viper or Daboia (*Vipera russelli*) .— Adults maximum length: 1000 mm (39inch). Body is stout and rough. Scales are strongly keeled. Triangular head broader than neck; scales on upper surface of head small and strongly keeled; nostril very large. Eye has vertical pupil. Tail is short and thin. Colour pattern is brown or yellowish-brown, with three longitudinal series of prominent, large brown or black oval or round spots. The "Spots" may have pointed ends, may meet to form a chain-like pattern, or may have narrow white or cream margins. Top of head usually has narrow white Λ shaped mark and a pair of triangular/oval dark brown markings. Two dark triangular streaks are behind and below eye. **Status:** IW(P)Act, Schedule II.

B. LIZARDS

(i) Yellow bellied House Gecko (*Hemidactylus flaviviridis*).— Standard length 42-90 mm.; tail length 38-90 mm. The common gecko with a pale-grey or greenish-grey, brown or olive dorsum; back is with wavy, dark cross bands, which are clearly visible during the day. The belly is yellowish. Head is large with a board snout; ear opening is sub-circular; head is covered with minute granules, which become more prominent and large on the snout. Dorsum is with small granuler scales, intermixed with very few larger, rounded, feebly keeled tubercles; ventrum is with smooth, rounded, imbricate scales, those on the gular region are quite small and flat. Tail is almost equal to the head and body, strongly depresses and swollen at the base in the adults. Male with 5-7 femoral pores on each side.

(ii) Indian Garden Lizard (*Calotes versicolor*).— Standard length 86-129 mm.; tail length 300-350 mm. Two small groups of spines, perfectly separated from each other, above each tympanum. Dorsal crest moderately elevated on the neck and anterior part of the trunk, extending on to the root of the tail in large individuals, and gradually disappearing on the middle of the trunk in younger ones. No fold in front of the shoulder, but the scale behind the lower jaw is much smaller then the other; gular sac not developed. From thirty-nine to forty-three series of scales round the middle of the trunk. The hind foot (measured from the heel to the extremity of the fourth toe) is not much longer than the head in the adult, whilst it is considerably longer in the young. The body is compressed,

dorsal colour light-brown grayish, transverse spots on back and sides, dark streak from eyes; head is large, swollen at angle of jaws in males; eye large; males with gular sac; limbs long well developed; digits long, slender, slightly compresses laterally, strongly clawed; tail almost round and slender. It is arboreal species in a true sense.

C. TORTOISE

Black-spotted Turtle or Black Pond Turtle (*Geoclemys hamiltonii*).— Large species average length 31 cm. The head is large, broad, snout rounded, as long as the orbit and slightly projecting beyond the lower jaw. Skin of the posterior portion of head is divided into large shields. Its shell is dark brown or black, marked with yellowish spots and streaks. The carapace is tricarinate, strongly convex with three interrupted keels in addition to the vertebral and costal keels; posterior margin serrated. Limbs are with fully-webbed digits and have transversely enlarged scales. Tail is quite short in comparison to body, covered below with small granular scales. Generally dorsal coloration is dark brown to black and richly spotted and streaked with deep yellow. Soft parts are dark brown to back with numerous round yellow spots, which are largest on the head and neck. Major threats to the species are over exploitation of their eggs and adults for flood. Habitat destruction has occurred because of construction of hydro-electric dams and barrages. Nesting areas are lost for commercial removal of sand and cleaning of riverside aquatic vegetation leading to scarcity of food sources and exposure of the banks to soil erosion. **Status:** IW(P)A 1972 Schedule 1; IUCN(2011): VU A1d+2d ver 2.3.

AMPHIBIANS

The amphibian fauna of the area comprises frogs and toads.

A. FROGS.—The following three species of frogs are known to occur in the district.

(i) Indian Bullfrog *(Hoplobatrachus tigerinus)*.— Standard length from snout to vent 16.51 cm (6.5 inches); Head moderate; Snout more or less pointed; *canthus rostralis* obtuse; nostril a little nearer to the end of the mouth than to the eye; inter-orbital space narrower than the upper eyelid; tympanum distinct, about two third the size of the eye. Fingers rather short, first extending beyond second; toes moderate, obtuse, nearly entirely webbed, no outer tubercle, a tarsal fold. Skin of back with longitudinal folds; a strong fold above the tympanum. Green or olive above, with dark spots; often a light vertebral line. Male with two

subgular vocal sacs, conspicuous externally by fold of the skin on the sides of the throat; these region generally blackish.

(ii)Paddy field Frog or Cricket Frog *(Fejervarya limnocharis)*.— The cricket frog is a species of frog found in South Asia which measures 5.08-12.7 cms (2-5 inches) from snout to vent. Greenish or olive, with darker spots; a light vertebral line or bank frequently present; sometimes a light line along the inner side of the leg; sides of thighs black-marbled; throat of male usually with two large black blotches, sometimes connected and forming a 'M'. *Fejervarya limnocharis* is closely allied to *Rana tigerina* from which it differs in its smaller size, half-webbed toes, slight development of the fringe on the fifth toe, and usually in the presence of a small outer metatarsal tubercle. Molecular studies of the species complex suggest that there may be multiple species involved.

(iii)Indian Skipper Frog or Skittering Frog *(Euphlyctis cyanophlyctis)*.— The skipper frog is a common frog found in South Asia. They are slimy and are often seen at the edge of bodies of water with their eyes above the water and move away noisily from the shore when disturbed, giving them their common name. They are rarely seen outside water. Their skin has small tubercles and units above, and with more or less distinct rows of pores. Brown or olive above, dark spotted or marbled; two blackish streaks on the hinder side of the thighs, seldom absent; beneath often speckled with blackish. Male with two external vocal vesicles, opening by two slits beneath the angles of the mouth. Fingers slender, pointed, first not extending beyond second; toes webbed to the tips, which are pointed, fourth not much longer than third of fifth; outer toe strongly fringed. They have the ability to leap out of the water from a floating position.

B. TOADS

Common Indian Toad (*Duttaphrynus melanostictus*).— This species of toad is common in South Asia. Standard length from snout to vent is 20 cm. The wart patterns are unique and have been used for individual identification in studies. The top of the head has several elevated bony ridges. The species breeds during the monsoons and the tadpoles are black. Young toads may be seen in large number after the monsoons. Upper surface is covered with more or less prominent, often spiny, warts; parotids very prominent, kidney-shaped or elliptical, more or less elongate. Yellowish or brownish above, the spines of the warts and the ridges of the head are generally black; beneath immaculate or more or less spotted. Male have a subgular vocal sac and black nuptial excrescences on the two inner fingers. These toads are often seen at night under street lamps especially during times when winged termites swarm. They feed on a wide range of invertebrates including scorpions. Tadpoles have ability to recognize kin.

FISH

The fish fauna of Panipat district shows the diversity due to presence of perennial water bodies like river Yamuna, village ponds, etc. The fishes are not only a source of economy to the people, but they also act as bio-indicator of the environment of particular ecosystem. The common fishes found in the district Panipat are Rohu (*Labeo rohita*), Bata (*Labeo bata*), Gonius (*Labeo gonius*), Pari (*Notopterus notopterus*), Mirgal (*Cirrhina mrigala*), Kandri (*Barilius bendelists*), Dolla (*Channa spp*.), Striped Mystus (*Mystus vittatus*), Mullee (*Wallago attu*), Gobi (*Glossogobius girius*), Bam (*Mastacemblus armatus*), Fire-fin Barb (*Puntius ticto*), Spot-fin Barb (*Puntius saphore*), Flying Barb (*Esomus Danricus*), Red-finned Mahseer (*Tor tor*), Freshwater Garfish (*Xenetodon cancila*), Olive-green Snakehead (*Ophtiocephalus punctatus*) etc. Most of these fishes are commercially important.

INVERTEBRATES

The main invertibrates known to exist in the district are as follows: Annelida (Earthworms); Crustacea (Crabs, Isopods, etc.); Archnida (Spiders and Scorpions); Myriapoda (Centipedes, Millipedes, etc.); Mollusca (Snails and Slugs); and Insecta. The common insects known to be found in the area belong to the following insect orders, viz., Isoptera (Termites or White Ants), Orthoptera (Grasshoppers and Crickets), Dermaptera (Earwigs), Odonata (Dragon and Damsel Flies), Hemiptera (Bugs, etc.), Diptera (Flies, Mosquitoes, etc.), Hymenopterra (Bees, Wasps, etc.), Coleoptera (Beetles), and Lepidoptera (Butterflies).

The butterflies are the most beautiful insect, easily recognizable of all other insects and second in number in their universal popularity after birds because of their bright colour patterns, mimicry and migration. They are good pollinators and help in cross pollination of flower and other plants. The common butterflies of the district Panipat are: Common Mormon (*Papilio polytes*), Lime Butterfly (*Papilio domeleus*), Psyche (*Leptosia nina*), Pioneer (*Anaphaeis aurota*), Cabbage White (*Pieris canidia*), Large Cabbage White (*Pieris brassicae*), Bath white (*Pieris daplidice*), Common Emigrant (*Catopsilia crocole*), African Emigrant (*Catopsilia pyranthe*), Common Grass Yellow (*Eurema hecabe*), Plain Tiger (*Danaus chrysippus*), Common Tiger (*Danaus genutia*), Common Indian Crow (*Euploea core*), Common Bushbrown (*Mycalesis perseus*), Dark Brand Bushbrown (*Mycalesis mineus*), Yellow Pansy (*Junonia hierta*), Blue Pansy (*Junonia orithya*), Lemon Pansy (*Junonia Lemonias*), Peacock Pansy (*Junonia almana*), Chocolate Pansy (*Junonia iphita*), Painted Lady (*Cynthia cardui*), Common Pierrot (*Castalius rosimon*), Pea Blue (*Lampides boeticus*), Large Hedge Blue (*Celastrina huegelii*), Pale Grass Blue (*Pseudozizeeria maha*), etc.

TOPOGRAPHY

The district is a part of the great Indo-Gangetic alluvial plain. It is a major tectonic basin filled up with detritus materials. These detritus materials commonly known as alluvium were deposited during the Quaternary Geological Period. Geologically, it is young and hence topographic expressions that have developed on this plain through times present a monotonously flat surface with very imperceptible relief. The elevation of alluvial plain is marked by a contour line of 230 m above mean sea level which crosses the centre of the district in the east-west direction. However, close study of the physiography reveals significant variations in the district.

Topographically, the district may be broadly divided into two units by a watershed running approximately parallel to Delhi-Ambala railway line. The region lying on the east of this railway line is referred to as the *Khadar*, while the western part is known as the *Bangar*.

The Khadar.—The area of the district varies from 20 to 30 kilometre in width in its total stretch lying from north to south along the right bank of the river Yamuna. The land area in this tract has gentle grade and slopes towards the river Yamuna. The topography of this region is dotted with numerous buried water channels, paleo-channels, oxbow lakes, meander/ scrolls, point bars etc. The presence of such features indicate that the region has been extensively traversed by the river Yamuna in recent past. As a result, the region possesses a light medium to coarse grained soils with excellent sub-surface and surface drainage which are free of salt hazards. With underground water table close to the surface and other favourable conditions as mentioned earlier the region is ideally suitable for the cultivation of rice, wheat, sugarcane and several creeping crops.

The Bangar.—It lies to the west of the watershed and slopes imperceptibly towards south-west of the area. The tract occupies a higher topographic position than the Khadar and is neither affected by the recent fluvial activity nor does it show any characteristic of the Khadar. The soils in this region contain typical deposits of calcium carbonate nodules at varying depths. It is locally, referred to as '*Reh*' or '*Kallar*'. These concretions and salt encrustations are evaporates formed by the evaporations or soil capillary and stagnant waters during periods of high thermal efficiency in the dry periods. These salt accumulations are, therefore, rich in carbonates, sulphates and chlorides of sodium, calcium and magnesium. It is characterized by poor to good surface and sub-surface drainage. The soils in this region are suitable for cultivation of variety of crops like wheat, rice, sugarcane etc.

RIVER SYSTEM, CANALS AND DRAINAGE

The Yamuna river shares a common boundary of 34 kilometres between Uttar Pradesh and Panipat district. During the course, the river falls in elevation from 219 to 209 metres, giving it a very gentle gradient of about 1 metre per 5.44 kilometres. The river enters the Panipat district at Rana Majra village and leaves the district at village Rakshera.

Yamuna river has a great history mostly shrouded in mystery. The name Yamuna is mentioned in connection with Dasrajana, the battle of the Ten Kings mentioned in the *Rigveda.* According to some scholars, the Yamuna in early times used to flow into the course of river Saraswati and was a tributary of the Ghaggar, like the Satluj, which was an independent river system running in the Hakra Bed and draining into the Rann of Kutch. For reasons yet to be fully investigated, the Yamuna-Satluj Plain is said to have experienced an uplift which dismembered the then river system, the Satluj shifting to the west and the Yamuna to the east, leaving the Ghaggar a truncated independent stream with utterly inadequate water-supply for maintaining its flow up to the Rann of Kutch.

The presence of ox-bow lakes in the Khadar is indicative of an eastward drift of river, and the available records also support the view that about four hundred years ago, Panipat town was situated on the bank of this river. *Bhuri Nadi* has been known in the recent past to flow regularly in flood times, the floods passing from the river above village Dhansauli and running down the old bed as far as Delhi in some parts, the last occasion being in 1864. Later the river suddenly changed its course in some parts while in others it gradually retreated. Now the Yamuna seems to have stabilized its course and there have been no significant changes in it during recent decades.

The district possesses a good network of canals emanating from Western Jamuna Canal (WJC), Delhi parallel Branch, Carrier Line Channel (CLC) which passes through the centre of the district in North-South direction. The WJC takes off from the Yamuna river at Tajewala where a strong masonry weir is built. There is a regulator at Indri and canal bifurcates into Sirsa Branch and Main Branch. Again Main Branch bifurcates into Hansi Branch, Delhi Branch and Gohana Distributary at Munak in Karnal district. Near Munak after bifurcation, the Hansi Branch entering from the North-Western edge of the district passes into Jind district and the Delhi Branch of the WJC after entering the district takes a direction towards Panipat town and then goes southwards and enters Sonipat district. Main distributaries that irrigate the Bangar area are Gohana Distributary, Israna Distributary, Naraina Distributary, Bazidah Distributary, Hulana Distributary and Samalkha Distributary. Main Drain No. 2 which has been dug out, to solve the water-logging problem and to channelise the flood waters of the Chautang Nadi during rainy season, starting from Kurukshetra district passing through Karnal district and ending in Panipat district, where its waters are thrown

in the Yamuna river. The factors that contribute to water-logging are obstruction of flood water by roads, railway lines and canals, secondly unlined canals due to seepage also pose a menace and thirdly the poor internal and surface drainage cause water logging which generally develops salinity and alkalinity in the lands where no crop can grow[13]. In addition to above there are nine river complexes (Rana Majra, Pathargarh, Tamsabad, Nanhera, Goela Khurd, Mirjapur, Khozkipur, Bilashpur and Rakesara) and a network of 44 drains having a length of 373 kilometres in the Panipat district. Flood protection works are regularly undertaken and the district is safeguarded from furry of flood in river Yamuna.

CLIMATE

Panipat region falls in sub-tropical region of India. The climate of this district is characterized by the extreme dryness of the air, with an intensely hot summer and a cold winter. It is only during the three monsoon months; July, August and September, moist air of oceanic origin penetrates into the district. The year may be divided into four seasons. The cold season from mid-November to about mid-March is followed by the hot season, which continues to about the end of June. July to about mid-September is the southwest monsoon season. Mid-September to mid-November constitutes the transition period from the monsoon to winter conditions. The temperature varies from as high as 45°C in summer to a low of 3°C in winter. Temperature drops considerably with the advancement of monsoon in June. The weather becomes milder during the monsoon (period July to September) with an increase in humidity and frequent rains. The post-monsoon months - October and November constitute a transition period, prior to the onset of winter. The winter starts in December when day and night temperatures fall rapidly. During cold, the minimum temperature may, sometimes, go down to the freezing point of water and frosts can occur due to cold-waves.

Rainfall.— Records of rainfall in the district show that the average annual rainfall in the district is 615.1 mm. About 84 percent of the normal annual rainfall in the district is received during the months June to September. August is the rainiest month with an average value of 203.6mm. Some rain is also received during the cold season, which is associated with passing western disturbances. The variation in the annual rainfall from year to year is large. In the 50 years period from 1951-2000, the highest annual rainfall amounting to 191 percent of the normal occurred in 1958, while the lowest annual rainfall; which was only 32 percent of the normal, occurred in 1974. The annual rainfall in the district was between 401 and 800mm in 24 years out of 38 years, the details of which may be seen in Table-II and III of Appendix. During the same period form 1951-2000, there were 15 years in which the annual rainfall was less than 80 percent of the normal and only two consecutive years of such low rainfall occurred six times. On an average there are 30 rainy days (i.e. days with rainfall of 2.5mm or more) in a year in the district. The heaviest rainfall in 24 hours recorded in the district was 254.0 mm at

Panipat on 19th September 1933. The rainfall during 2006 to 2010 in the district Panipat is given in Table-IV of Appendix.

Temperature.— There is no meteorological observatory in the district. So the records of the observatory in the neighbouring district of Karnal may be taken as representative of the climatic conditions in the district in general. The cold season generally starts by about mid-November when temperatures begin to decrease rapidly. January is the coldest month with the mean maximum temperature at about 20.0°C and the mean minimum at about 7.0°C. In association with the passage eastwards of western disturbances in the cold season, cold waves affect the district and the minimum temperature sometimes goes down to 0°C degree on individual days. From about the middle of March, temperatures begin to rise rapidly. May and June are the hottest months with the mean maximum temperature at about 39°C and the mean minimum temperature at about 25°C. From April, hot westerly winds, locally known a '*Luh*' begin to blow and weather progressively becomes intensely hot and trying. In May and June the maximum temperature may sometimes go above 45°C on individual days. The temperature varies from as high as 45°C to a low of 1°C in winter. Temperature drops considerably with the advancement of monsoon in late June. The weather becomes mild during the monsoon (July to September) with an increase in humidity and frequent rains. With the advance of the southwest monsoon in the district towards the end of June, there is appreciable drop in the day temperatures while night temperatures continue to be high as in summer. Even during the southwest monsoon season the weather is sometimes unpleasant due to the damp heat in the monsoon air between two spells of rain. After the withdrawal of the monsoon by about mid-September there is a slight change in day temperatures, but night temperatures drop down rapidly with the progress of the post monsoon season. The post monsoon months mid-September to mid-November constitute a transition period prior to onset of winter. The winter starts from the end of November when day and night temperatures fall rapidly. During winter season the minimum temperatures may sometimes go down to the freezing point of water and frost can occur due to cold waves.

Humidity.— The air is generally dry over the district during the greater part of the year. During the monsoon season the humidity is high, generally between 65 and 80 percent. Humidity decreases in the post monsoon season. April and May are usually the driest months, with relative humidity being about 35 percent or less in the afternoons.

Cloudiness.— During the southwest monsoon season and particularly during July and August skies are heavily clouded or overcast. In the rest of the year skies are clear or lightly clouded generally. During the period, January to early March, skies become cloudy and often overcast in association with the passage of western disturbances.

Winds.— Winds are in general light over the district with some strengthening in force during the summer season. During the monsoon season, winds are mostly southeasterly. During the rest of the year winds are predominantly northwesterly. During the monsoon the sky is heavily clouded and winds are strong in this period. Winds are generally light during the post monsoon and winter months. The winds blow from west in winter and east in summer.

Special Weather Phenomena.— April to June is the period with the highest incidence of dust-storms and March to September is the period with the highest incidence of thunderstorms. Violent squalls (*Andhiyan*) often accompany such storms during the period April to June. Generally, the thunderstorms are often accompanied with heavy rain and occasionally hail barring only a few. Thunderstorms also occur in the winter months in association with passing western disturbances. Fogs sometimes occur in cold season.

GROUND WATER

The district is occurred by geological formation of Quaternary Age comprising of recent alluvial deposits belonging to the vast Indo-Gangetic alluvial plain. Central Ground Water Board has drilled four exploratory boreholes[14] in the depth range of 103 to 460 m and 29 piezometers in the depth range of 33 to 348 m to delineate and determine potential aquifer zones, evaluation of aquifer characteristics, behaviour of water levels etc. Studies have revealed the existence of 8–23 granular zones down to a maximum depth of 460 m. These zones mainly comprise of various grades of sand and gravel. The first granular zone forms the water table aquifer and occurs down to 50–150 m below ground level. The second aquifer occurs between 130 and 250 m depth, the third one exists between 286 and 366 m depth. Total thickness of the alluvium is not precisely known. However, the bedrock has not been encountered up to 460 m depth at village Dadlana (deepest exploratory borehole) in the district. The discharges range from 605 to 3258 lpm (litres per minute) for 6 – 20 m of draw down. The transmissivity of the aquifers lies between 350 and 1990m²/ day.

The depth to water level ranges from 2.2. to 26.93 m bgl (metres below ground level) during pre monsoon period (May 2010) and between 1.66 to 26.18 m bgl during the post monsoon (Aug.2010). The depth to water level is shallow in northern part and deeper in southern part. The deepest water level is normally reported from parts of Panipat and Samalkha block. In major part of the district water level varies between 5 and 20 m bgl.

The long-term net change of water levels indicates a general decline (negative change) in a large part of the district and it is up to 5.83 metre. The maximum falls is observed around Panipat town in Panipat block. The overall flow of ground water is towards south-west direction.

Ground Water Resources.— The block wise ground water resource potential in the district has been assessed as per GEC-97. As per ground water resources, estimation as on 31st March, 2009, the ground water development in all the blocks has exceeded the available recharge and thus all the blocks have been categorized as "Over Exploited." The stage of ground water development ranges between 127 per cent (block-Madlauda) to 210 per cent (block Samalkha). The net ground water availability of Panipat district is 30,865 HAM and stage of water ground development of the district is 167 per cent.

Ground Water Quality.— The shallow ground water of the district is alkaline in nature and is of low to medium salinity. The data on chemical quality of water from shallow (Phreatic) aquifers indicates that all the chemical parameters i.e. major Cations (Ca, Mg, Na & K) and major Anions (CO3, HCO3, CL & SO4) are well within the permissible limits set by the Bureau of Indian Standards (BIS) in 1991 in most areas, but higher concentrations occur at some places. Among the anions, bicarbonate is dominant, and magnesium and sodium are the dominant cations. Marginal quality water is found in the South Western parts of the district Madlauda and Israna blocks. High fluoride is found in large parts of the district more than 60 percent. High nitrate concentration is found in patches in Madlauda block. The ground- water is suitable for irrigation based on the USSL diagram for classification of irrigation waters. However, for drinking some constituents are high and fluoride problem is prevalent in large parts. High concentrations of heavy metals like Copper and Iron have been found.

In the industrial belt of Panipat, ground water is polluted by the nitrate and fluoride in some parts and is polluted by heavy metals like Mn, Pb and Fe at many places. Heavy metals like Cd., Ni, Zn, Cu, Co, Sr are also found in low concentrations. Ground Water is hard in a large area and in some parts of the city is unsuitable for drinking. Deeper ground water is by and large safe.

Status of Ground water Development.—Shallow tube-wells are the most important ground water development structures in the district and have shown a tremendous growth in the past years. There are 29,855 shallow tube-wells in the district. Most of the existing units are cavity wells. Filter wells are found along the river Yamuna in the eastern part of the district. The average depth of tube-wells in the district is 60m, varying between 12 to 80m tapping aquifer between 10 to 80m. The discharge varies from 8 to 14 lps.

Geophysical.— Surface resistivity surveys have been carried out in two blocks Madlauda and Israna of the district. These studies indicate that ground water is saline in major areas of these two blocks but the depth of occurrence of salinity is variable. The central part of both the blocks has saline ground water at all levels. This area is surrounded by shallow ground water salinity where ground water is saline below a depth of 10-20m. These are followed by areas of fresh water up to 20-50m. Fresh water occurs up to a depth of 50-80m in a patch around Madlauda

extending northwards up to the north eastern boundary of the district. Deep ground water below 100m is saline throughout these two blocks.

Ground Water Problems.— In Madlauda and Israna blocks where ground water level is less than 2m bgl water logging occurs in some areas. An area of about 50 sq. km is water logged and about 62 sq. km area is prone to water logging with less than 3m water level. Water level decline is occurring in a large part of the district covering Panipat, Samalkha and Bapauli blocks and parts of Israna and Madlauda blocks. The water levels are falling at a rate of 2 to 151 cm/yr. The maximum fall of water level is observed in parts of Samalkha and Panipat blocks. Water quality problem occurs in some parts of the district. Medium salinity occurs in parts of Madlauda and Israna blocks. Fluoride problem occurs in a large area falling in all the blocks with the maximum concentration in Israna block.

Notes and References

[1] Vide Haryana Govt. Notification No. S.O.147/P.A.17/1887/S.5/89, dated October 16, 1989
[2] Vide Haryana Govt. Notification No.S.O.155/P.A.17/1887/S.5/91, dated December 31, 1991
[3] H.R.Gupta, Maratha and Panipat, 1961, p.176
[4] For details see Chapter-XIX on 'Places of Interest'
[5] Historic and Archaeological Heritage of Panipat, Article by Devender Handa (The Battles of Panipat) p17.
[6] Sonipat District Gazetteer, 1990, p.2
[7] Delhi District Gazetteer, Part A, 1912, p. 42
[8] Karnal District Gazetteer, 1976, p.3
[9] *Ibid*, 1883-84, p51
[10] Census of India 1991, Series 8 Part XII- A and B. District Census Handbook District Panipat, p.12.
[11] Haryana Government Notification No. S.O.155/PA 17/1887/S.5/91 dated 31st December, 1991.
[12] Census 2001, District Census Handbook. District Panipat pp. 5-6
[13] Census of India 1991, Series 8, District Census Handbook, Panipat, p.18
[14] Ground Water Information Booklet, 2007 by the Central Ground Water Board, Government of India, Chandigarh, Para 4.1