CHAPTER I

GENERAL

ORIGIN OF THE NAME OF THE DISTRICT

The district is named after its headquarter town of Jhajjar. The town was inhabited about 800 years ago, and has many pages of history engulfed in it. Delhi and its adjoining areas were worst affected in the battles between Mohammad Ghori and Prithvi Raj in 1191-92 A.D. There was a village named Malokan in the east of present Jhajjar town, mostly inhabited by Jats which was also amongst ill-fated villages that were devastated during these battles. The survivors had to desert their homes and belongings in search of food and livelihood. When rule of Ghori was established in Delhi, villages started inhabiting again. Brave Chajju Jat, resident of Malokan village made an appeal to Emperor Ghori to rehabilitate the village. Malokan village had fought bravely to defend the country against Ghoris, probably due to that Emperor rejected the appeal of residents of Malokan and ordered to rehabilitate village somewhere else, and with this order, foundation of Jhajjar was laid by Chajju Jat[1]. Thus, the town was named as Chhajunagar after his name which was later on changed to Jhajjar.

According to other theories, the name is a derivation from *Jharnaghar*, a natural fountain, or from *Jhajjar*, a water vessel, because the surface drainage of the country for miles around runs into the town as into a sink.[2]

LOCATION, BOUNDARIES, AREA AND POPULATION

Location and boundaries.— The district lies in 29º21'30" to 29º51'30" North latitude and 76º16'30" to 76º58'45" East longitude. This, star-fish shaped district, is located in the centre of southern Haryana. It is bounded on the north by Rohtak and Sonipat districts, on the south by Rewari and Gurgaon districts, on the west by Bhiwani and Charkhi Dadri districts and on the east by Delhi, the National Capital.

1 Vinay Deswal:'*Role of Deputy Commissioner in Rural Development a study in Haryana*', Shodhganga, 2013, pp.89-90

2 Rohtak District Gazetteer, 1970, p.328

Area.— The district has a geographical area of 1834 square kilometres, which is 4.1 percent of total area (44,212 sq. km.) of the State. Out of the total area, 1752.88 square kilometres is rural area and 81.12 square kilometres is urban area. Jhajjar is ranked 10th in size amongst the 21 districts of the State.

Population.— According to Census 2011, the district has a population of 9,58,405 (5,14,667 males and 4,43,738 females). Rural population is 74.61 percent of the total population, which accounts for 7,15,066 while urban population accounts for 2,43,339. Population wise it stands 17th in the State with 3.8 percent of total population *viz.* 2,53,51,462 persons.

HISTORY OF THE DISTRICT AS AN ADMINISTRATIVE UNIT

The areas of Jhajjar district underwent great reshuffle, extending over hundreds of years before the administrative unit emerged in its present form. The administration of the area was under the broader control of Rai Pithora (Prithvi Raj Chauhan-III) of Chahmana dynasty, the ruler of Delhi, and in actual control of Gobind Raj[1]. With the defeat of Prithvi Raj in 1192 A.D., the administration of this area went in the hands of Mohammad Ghori. The Sultanate of Delhi established in 1206 A.D. depended on the support of Muslim nobles of Jhajjar on account of its nearness to Delhi. The area of Rohtak-Jhajjar influenced the struggles among the aspirants for the throne of Delhi. Towards the end of the Tughlaq dynasty, the administration of the *area* of Jhajjar was under the control of Nasiruddin Nusrat Shah as a *shiq* of Delhi Sultanate[2]. Under the Mughal Emperor Akbar, when his minister Todar Mal divided North India into administrative circles, the area of Jhajjar (as a *pargana* of *suba* of Delhi) fell within the *sarkars* of Delhi and Hissar Firuza. The tract was often granted in military jagir by the Sultans and Mughal emperors to the Nobles of the court. As per authentic historical sources, the Mughal Emperor Jahangir granted the area of nearby village Sikanderpur to his loyal *Kalal* official as *jageer*. After the death of Bahadur Shah-I (1707-12 A.D.), the successor of Aurangzeb, the Mughal empire began to decline rapidly. The area in which Jhajjar lay frequently experienced a change of masters.

1 Azad Singh Chahal, *Jhajjar : Itihaas Ke Aainay Mein*, 2011, p.25

2 H.A.Phadke, *Haryana Ancient and Medieval*, 1990, pp.121-22

The claims of the imperial grantees were contested sometimes by the Rajputs, Jats and Sikhs and often by the Marathas. In 1794 A.D., George Thomas extended his authority up to Jhajjar and made it as his headquarter. Jhajjar was divided into parts after his departure, thus, Haryana including Jhajjar region experienced around half a dozen changes in its administration catering to the taste, convenience, and whims of the colonial masters.

After the treaty of Surji Anjangaon signed on December 30, 1803, Jhajjar estate was passed to the British and came under the administration of the North-Western Provinces. The British had no intention at that time to hold large territories beyond the Yamuna. Accordingly in 1822, Jhajjar estate, which included Badli, Kannuad and Narnaul, Patoda, Bawal, Badwana, Kanti *parganas*, was given to Nawab Nijabat Ali Khan, a leader of free lancers, thus establishing Jhajjar as the biggest estate in Haryana. Bahadurgarh estate was given to his brother, Nawab Ismail Khan. The villages of Lohari, Patauda and Kheri Sultan in the south-east corner of Jhajjar with estate of Hassangarh were given as a separate jagir to Faiz Muhammad Khan, son of Nawab Nijabat Ali Khan. Beri, which was part of Rohtak district, was first given Rohilla Chief Bambu Khan, later on was transferred to Nawab of Dujana, who resigned the major portion of the gift in 1809 A.D. because it was beyond his power to manage it. Only Dujana and Mehrana were left to him for rule. In 1824 A.D., when Rohtak was formed as a separte unit, Bahadurgarh territory formed its eastern and Jhajjar its southern boundary. Until 1832, the whole area was under the Resident at Delhi but in the same year it was brought under the same regulations as the rest of North India. After breaking of Rohtak district in 1841 A.D., Bahadurgarh estate which was earlier part of Rohtak district was merged in Jhajjar estates and its administration was handed over to Nawab Muhammad Ismail Khan.

In April 1858, Jhajjar along with rest of Delhi and Hissar divisions was detached from North-Western Provinces after 1857 and tagged with the Punjab administration by the Government of India vide Notification No. 606 of the 13th April, 1858. After its transfer to the Punjab, the Bahadurgarh estates were added to the Sampla tehsil, five detached villages confiscated from Nawab of Jhajjar for siding against British in events of 1857, were added to Bhiwani tehsil. Jhajjar

came directly under the control of British rule and was reconstituted as a new district consisting the areas of Kannuad, Narnaul and Dadri. In 1860, its status as district was forfeited and it was annexed to Rohtak district as a tehsil. Jhajjar tehsil, as a part of Rohtak district, remained in Hissar Division until 1884. Two detached Jhajjar estates were given to Raja of Jind while several of Badli villages were transferred either to Delhi or Gurgaon. On the abolition of Hissar Division in 1884, Jhajjar was again attached to Delhi Division. By the Notification No. 224 of 3rd June, 1910, Sampla tehsil was abolished for reasons of administrative economy and its area was divided between Jhajjar and Rohtak tehsils. Jhajjar tehsil, as a part of Rohtak district, was attached to Ambala Division after separation of Delhi territory from Punjab in 1912[1].

Earlier Jhajjar tehsil, as a part of Rohtak district, was annexed to Punjab in 1947 after independence, and Dujana State was merged in Jhajjar tehsil in 1948. In 1966, when Haryana was created as a separate State, Jhajjar became a sub-division of Rohtak district. As per 1971 Census, Jhajjar tehsil consisted of 309 villages and 3 Municipal Committees namely Beri, Bahadurgarh and Jhajjar. Bahadurgarh was formed as a tehsil on 31st October, 1973 by transferring 55 villages from Jhajjar tehsil. In 1974, 13 more villages from Jhajjar tehsil and 11 villages from Rohtak tehsil, were added to Bahadurgarh tehsil, making a total 79 villages in it. Jhajjar lost total 68 villages to Bahadurgarh tehsil.

At the time of Census 1981, Jhajjar tehsil consisted of 241 villages and two towns Beri and Jhajjar. Bahadurgarh tehsil consisted of 79 villages and one town i.e. Bahadurgarh itself. Jhajjar tehsil lost 52 villages to newly formed Kosli tehsil on 11th February, 1980. Jhajjar tehsil, however, gained 1 village Kheri Asra from Bahadurgarh tehsil on 28th April, 1980, and 9 villages on 17th October, 1989. Bahadurgarh lost 17 villages i.e. 10 villages to the Jhajjar tehsil, one village to Rohtak tehsil and 6 villages to Sonepat tehsil of Sonipat district without gaining a single village from outside the district. Matanhail sub-tehsil was formed on 17th February, 1984 by excluding 38 villages from Kosli tehsil of Rohtak district, and 5 villages of Jhajjar tehsil. The reorganization of the Rohtak district was undertaken

1 Rohtak District Gazetteer, 1970, pp.3-4

from November 1989 resulting in creation of Badli, Beri and Matanhail as sub-tehsils on 7th July, 1992. Later on, Badli as sub-tehsil was abolished.

The district underwent subsequent changes during 1991-2001 in the event of composition as per census 2001. Jhajjar tehsil gained total 6 villages from Kosli tehsil of Rewari district on 31st July, 1995 and lost 9 villages to Bahadurgarh tehsil on 24th July, 1991. Bahadurgarh tehsil lost 2 villages to Rohtak tehsil on 28th February, 1992. Beri tehsil was newly created on 27th July, 1995[1] by transferring 47 villages from Jhajjar tehsil and Beri town itself.

Jhajjar was formed as a new district with Jhajjar, Bahadurgarh and Beri tehsils consisting of total 261 villages and 3 towns as on 15th July, 1997, and Jhajjar and Bahadurgarh were declared Sub-divisions. Beri tehsil lost 7 villages namely Gurha, Jondhi, Khatiwas, Birdhana, Mehrana, Fortpura and Tamaspura to Jhajjar tehsil. Two census towns of Ladrawan and Sankhol were newly formed and 3 villages namely Parnala, Bahadurgarh Rural and Hassanpur were treated as outgrowths of Bahadurgarh town. As a consequence of these transfers, Jhajjar tehsil decreased its strength of villages to 157. Bahadurgarh increased its strength of villages from 62 to 64 and Beri tehsil decreased its strength from 47 to 39 as per census 2001. The district as a whole consisted of 260 villages in 2001 census. Position of Jhajjar district as per 2001 census was as under:-

Tehsil	**Area in Sq. Kms.**	**Number of villages**		**Number of statutory towns**	**Number of census towns**
		Inhabited	**Uninhabited**		
Jhajjar	1031	153	4	1	-
Bahadurgarh	511	59	5	1	2
Beri	356	35	4	1	-
District Total	**1834**	**247**	**13**	**3**	**2**

One village Mangawas was newly created out of village Jahazgarh in Beri tehsil on 30th July, 2007. Matanhail sub-tehsil was upgraded as tehsil by transferring 53 villages from Jhajjar tehsil on 21st August, 2008 and Salhawas was

1 Haryana Government Notification No. S.O.74/P.A.17/1887/S.5/95, dated 27-07-1995

created as sub-tehsil[1] by transferring 22 villages from sub-tehsil Matanhail on 21st August, 2008. Beri was created a new sub division on 7th July, 2009[2] and gained 2 villages Birdhana and Mehrana from Jhajjar tehsil on 30th July, 2009. The district consisted of 4 tehsils and one sub tehsil, namely Jhajjar tehsil (101 villages and Jhajjar MC and Faizabad C.T.), Bahadurgarh tehsil (64 villages, Bahadurgarh MCL and Ladrawan C.T.), Beri tehsil (42 villages, and Beri town) and Matanhail tehsil (53 villages and no urban area). There were total 260 villages and 5 towns which includes 247 inhabited and 13 uninhabited in the district as per census 2011. In 2012, Jhajjar tehsil gained 2 villages Birdhana and Mehrana, and Salhawas sub tehsil lost 6 villages Khetawas, Koelpuri, Chadwana, Reduwas, Akheri Madanpur and Goria to Matanhail tehsil. On 4th November, 2016, a new tehsil Badli, comprising of 45 villages, was created as part of Bahadurgarh Sub-Division[3]. The new tehsil has gained 23 villages from Bahadurgarh tehsil, and 22 villages from Jhajjar tehsil.

As on 31st March, 2018 the position of villages, tehsil/sub-tehsil wise, is given below:-

Tehsil / Sub-tehsil	Year of formation as tehsil	Number of villages		Total
		Inhabited	Uninhabited	
Jhajjar	1860	76	6	82
Bahadurgarh	1973	43	3	46
Beri	1995	37	1	38
Matanhail	2008	36	1	37
Salhawas Sub-tehsil	2008	16	0	16
Badli	2016	39	6	45
District Total		**247**	**17**	**264**

GEOLOGY

As classified by the National Bureau of Soil Survey and Land Use Planning (ICAR) Nagpur, the district has mainly Orthids-Fluvents and Orchrepts types of

1 Haryana Government Notification No. S.O.80/P.A.17/1887/S.5/2008, dated 21-08-2008
2 Haryana Government Notification No. S.O.65/C.A.2/1974/S.5/2009, dated 30-07-2009
3 Haryana Government Notification No. S.O.53/P.A.17/1887/S.5/2016, dated 04-11-2016

soils. North western parts of the district contain loamy (Bhangar and Nardak) soils whereas the southern part contains coarse loam (Dohar and Check note) type of soils. The district is entirely covered by alluvial and aeolian deposits. The alluvial deposits, classified as Older Alluvium, form a part of Indo-Gangetic alluvium, deposited from middle Pleistocene onwards to Holocene by palaeo Indo-Gangetic river system. Older alluvium uncomfortably overlies the Delhi Super Group and Post Delhi intrusive rocks which are, however, not exposed anywhere in the district. Older alluvium is overlain by Aeolian sediments mainly in the southern and south western parts and as isolated patches elsewhere in the district.

Older Alluvium.— Older alluvium comprises of polycyclic sequence of sand, silt and clay with or without calcareous concretions (*kankar*) at various depths. The sediments are fine to medium grained, rounded to sub-rounded and well-sorted. The upper surface is characterised by highly oxidized brown to yellow clays, sandy clays and sand. The bore well data reveals the thickness of older alluvium varies from 160 m in south west near Matanhail to 350 m near Jhajjar town.

At few places recent to sub recent lacustrine sediments comprises clay, silty clay with or without *kankar and* gastropod shells also occur over older alluvium. Some of the prominent localities of occurrence of these gastropod shells are Machhrauli and Bhindawas. The major soils are Coarse, Loamy, Non-calc., Typic Ustorthents; Coarse, Loamy, Non-calc. Typic Haplustepts; Fine, Loamy, Calc., Typic Haplustepts; Fine, Loamy, Non-calc., Udifluventic Haplustepts; and Coarse, Loamy, Calc., Typic Ustorthents[1]. Since the soils are fertile with good irrigation facilities these have been put to maximum use over a long time. The alluvial plain again has been subdivided as follows:-

Plains.— These occupy mainly the northern, north eastern and north central parts of the district which are characterised by slight to moderate erosion, distinct parcelling and mixed tones due to variable moisture conditions.

Depressions.— The post-Pleistocene age sediments, which have filled the depressional areas, are mostly derived from the Himalayan rivers from the north.

1 Wastelands monitoring using multi-temporal satellite Data-District Jhajjar, Technical Report by HARSAC- 2010, p.12

The majority of the surface drainage is seasonal passing through linear depressional areas. The major soils are Fine, Loamy, Non-calc., Udifluventic; Fine Loamy, Calc., Typic Haplustepts; and Fine, Calc., Typic Endoaquents.

Sand Dunes.— Dunal ridges, interdunal plains with sandy Aeolian cover dominate the south-western part of the district such as near Sasroli, Salhawas, etc. The thickness of Aeolian sediments is composed a few centimetres to 5 centimeters. The sediments are composed of brown to yellowish brown, fine to very fine grained, almost equigranular sand consisting of quartz grains with little or no mica. Sedimentological studies indicate that Aeolian sediments are derived both from the Thar Desert of Rajasthan and local palaeo river system by local wind system.

MINERALS

Saltpetre.— Saltpetre is a general trade name for all the nitrates of sodium, potassium and calcium, but scientifically, nitrates of potassium are known as nitre or saltpetre, while those of sodium are called soda nitre. Saltpetre appears as salt efflorescence on the ground surface during the summer season. It is found in 49 villages of the district. Saltpetre encrustations are extensively worked around Jhajjar, Salhawas, Achhej, Gochhi, Beri, Jahazgarh, Dujana, etc. It is primarily used in the production of nitrates and potash. The best use of the refined product is in the manufacturing of gun powder, fireworks, and farm fertilizers. Potash is used in the manufacturing of soap, matches, explosives, glass and ceramic industry.

Kankar.— *Kankar* (lime) occurs in disseminated nodular form at various depths at Birohar, Chhuchakwas, Nogawan, Yaqubpur, Karodha, Gubhana and Saloudha. The *Kankar* of Gubhana and Saloudha falls under cement grade.

FLORA

The general floristic composition of the district belongs to dry-tropical to semi-arid type characterized by Indo-Gangetic plains marked with a vast stretch of flat land with occasional local undulations. The vegetation mainly comprises *Acacia modesta, Acacia nilotica* subsp. *indica, Acacia senegal, Alysicarpus monilifer, Alternanthera paronychioides, Alternanthera sessilis, Anagallis*

arvensis, Artemisia capillaries, Blepharis maderaspatensis, Bombax ceiba, Capparis deciduas, Capparis sepiaria, Capparis zeylanica, Cassia fistula, Cenchrus biflorus, Chrozophora oblongifolia, Citrullus colocynthis, Cleome viscose, Clerodendron inerme, Coccinia grandis, Commelina undulata, Boerhavia chinensis, Convolvulus arvensis, Convolvulus prostratus, Cordia dichotoma, Cordia myxa, Crateva adansonii, Crateva religiosa, Cedrela toona, Cyperus conglomerates, Eragrostis ciliaris, Euphorbia clarkeana, Ficus religiosa, Ficus cunia, Glinus lotoides, Holoptelea integrifiolia, Jacaranda mimosifolia, Leptadenia pyrotechnica, Leptadenia reticulate, Linum usitatissimum, Melothria maderaspatana, Mitragyna parvifolia, Nicotiana plumbaginifolia, Oldenlandia corymbosa, Pavonia zeylanica, Polygala irregularis, Prosopis juliflora,Salvadora oleoides, Sida ovate, Sesbania bispinosa, Tribulus terrestris, Medicago monantha, Vicia hirsuta, Zizyphus maruitiana, etc.

Aquatic Flora.— Aquatic vegetation is mainly found to grow in a few seasonal water bodies (ponds, lakes, canals, river embankment, etc.) and in Bhindawas and Khaparwas wild life sanctuaries in the district. The aquatic submerged *hydrophytes* include species of *Ceratophyllum, Hydrilla, Najas, Potamogeton, Vallisneria and Zannichellia*. Among those species having free floating upper parts and roots in the mud include *Ipomoea reptans, Marsilea minuta, Nymphaea nouchali, Potamogeton nodosus, Sagittaria guyanensis*, etc. Free floating species consists of *Azolla pinnata, Eichhornia crassipes, Lemna trisulca, Spirodela polyrrhiza, Trapa natans* var. *bispinosa, Wolffia microscopica*, etc. The marginal vegetation comprises of species of *Alternanthera, Cyperus, Cynodon, Fimbristylis, Glinus, Hemarthria, Phyla, Scirpus, Typha, etc.* The marshy vegetation includes *Bacopa monnieri, Monochoria vaginalis, Veronica anagallis-aquatica*, etc. Some tree species like *Acacia nilotica, Butea monosperma, Phoenix sylvestris, Tamarix aphylla, etc.* are often planted on marshy localities.

Planation/Avenue Tree.— Plantation is observed in the district in wastelands, along roadsides, railway tracts, in degraded forests, canal sides, etc.,in the mode of strip foresting. The common species includes *Acacia nilotica* subsp. *indica, Azadirachta indica, Caesalpinia crista, Caesalpinia pulcherrima, Eucalyptus globulus, Eucalyptus umbellatus, Lawsonia inermis, Malva sylvestris, Sesbania*

sesban, Polyalthia longifolia, etc. A number of species, grown for their ornamental value includes *Acacia leucophloea, Althea rosea, Anthocephalus chinensis, Bougainvillea spectabilis, Catharanthus roseus, Lagerstromia indica, Jacaranda mimosifolia, etc.* In the sandy part of Jhajjar tehsil, and round the wetlands, the *Tamarix aphylla* (farash) is the distinctive tree of countryside. It grows readily from cuttings and needs little water. *Tamarix dioica* (jhao) is also found occasionally in low-lying tracts in the south of the district. The *Salvadora persica* (kharjal) and *Balanites aegyptiaca (*hingo) are common in Jhajjar tehsil. There is a thick growth of somewhat scrubby trees, among which the *Acacia katechu* (khair) and *Acacia nilotica* subsp. *indica* (*babul*) are prominent in the government reserves in this tehsil[1].

Economic Plants.— A large number of economically important plant species play a vital role in the economic development of the district. Besides common food crops, *Abelmoschus esculentus, Brassica juncea, Carissa congesta, Cassia tora, Cicer arietinum, Cajanus cajan, Lathyrus sativus, Vigna mungo, Vigna radiate, Lens culinaris, Mangifera indica, Momordica dioica, Sorghum bicolour, Zizyphus mauritiana, etc.*, are widely used as major agricultural crops. The species like *Argemone mexicana, Azadirachta indica, Linum usitatissimum, Ricinus communis, Sesamum indicum, etc.*, are employed for extraction of oil. *Acacia nilotica* subsp. *indica, Cassia fistula, Tamarix aphylla, Zizyphus mauritiana, etc.*, are used in tanning industry. Among the fibre yielding plants *Abutilon indicum, Acacia leucophloea, Calotropis procerea, Crotalaria Juncea, Corchorus Capsularis, Corchorus olitorius, Cordia dichotoma, Gossypium arboretum, Gossypium hirsutum, Hibiscus cannabinus, Leptadenia pyrotechnica,* etc., are most important. The species like *Achyranthes aspera, Abrus precatorius, Terminialia chebula, etc.*, are used in preparing dye. Apart from these, the district is endowed with a rich diversity of medicinal plants, often used in preparation of ayurvedic, siddha and unani formulations, other traditional health care practices and in home remedies. Some of the important medicinal plants include *Ailanthus excelsa, Aegle marmelos, Abrus precatorius, Abution indicum, Acacia nilotica* subsp. *Indica, Achyranthes aspera, Adhatoda zeylanica, Bacopa monnieri, Boerhavia diffusa,*

1 Rohtak District Gazetteer, 1910, p.6

Calotropis procera, Cassia fistula, Centella asiatica, Crataeva magna, Lawsonia inermis, Leptadenia reticulata, Mallotus phillipensis, Sida cordifolia, Solanum nigrum, Tinospora cordifolia, Withania somnifera, etc.

Ruderal Plants.— Ruderal vegetation that has developed on disturbed habitats like waste places, railway tracts, road sides, etc., in the district includes *Abutilon bidentatum, Abutilon indicum, Ageratum conyzoides, Amaranthus viridis, Argemone mexicana, Aristolochia bracterolata, Calotropis procera, Capparis sepiaria, Chozophora oblongifolia, Commicarpus chinensis, Commicarpus verticillatus, Convolvulus arvensis, Conyza bonariensis, Corchorus aestuans, Corchorus alitorius, Cynodon dactylon, Datura innoxia, Echinops echinatus, Indigofera tinctoria, Malva parviflora, Malva sylvestris, Momordica balsamina, Ocimum canum, Oldenlandia corymbosa, Sida acuta, Sida cordata, Sisymbrium irio, Tridax procumbens, Streblus asper, etc.*

Common Weed.— The common weed associated with agricultural crops are species of *Argemone, Lepidium, Cleome, Polygala, Corchorus, Linum, Mellilotuts, Xanthium, Solanum, Amaranthus, Leucas, Euphorbia, etc.*

A list of local flora is given in Table-I of the Appendix.

FAUNA

Fauna is divided into two: Vertebrate and Invertebrate fauna

A. 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.

1. MAMMALS

Early in the 20th century, the district was well known for its large herds of antelope *(black buck-hiran)* and Indian Gazelle *(chinkara),* the latter being found chiefly in the southern part and the former in the northern. The position has changed since then and antelopes are almost on the verge of extinction. Chinkara is occasionally found in the areas of Salhawas, Dulina and

Jahangirpur in the Jhajjar tehsil. Fox, jackal and squirrel are commonly met with throughout the district. Wild cat is also not rare. Wolf, hyena and wild pig are now becoming rare. Nilgai *(blue bull)* was common, especially in the Chhuchhakwas Bir and Matanhail jungle, but in the famine of 1900, it almost disappeared[1]. Larger mammals found in the district, include Monkeys (*Macaca mulatta*)), three species of carnivores: Jungle Cat (*Felis chaus*), 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*). They ravage the sugarcane fields whenever they get a chance, prevent young trees from growing, and often threaten women and children carrying food to the fields. The people are unwilling, on religious grounds, to kill them.

The smaller mammals of the district include four species of the rodents: House Mouse (*Mus Musculus*), Common House Rat (*Rattus rattus*), Indian Gerbil (*Tatera indica*), Five-stripped Palm Squirrel (*Funambulus pennantii*); three species of bats: Indian Flying Fox (*Pteropus giganteus*), Common Pipistrelle (*Pipistrellus Pipistrellus*), and Indian Pipistrelle (*Pipistrellus coromandra*); and one species of Lagomorpha: India Hare (*Lepus nigricollis*).

2. AVES

Aquatic Birds.— The Bhindawas Wildlife Sanctuary in the district attracts around 35,000 individuals of migratory birds belonging to over 260 species during winter, and water problem at Bharatpur National Park of Rajasthan, thus this sanctuary provides an alternate winter site to the migratory water fowls which have enhanced its importance. This sanctuary is famous for its Water birds, and resident birds. Similarly the Khaparwas Wildlife Sanctuary attracts a large number of migratory birds. The ducks visiting these sanctuaries during winter are Graylag Goose (*Anser anser*), Bar-headed Goose (*Anser indicus*), Ruddy Shelduck (*Tadorna ferruginea*), Comb Duck, (*Sarkidiornis melanotos*), Northern Pintail (*Anas acuta*), Common Teal (*Anas crecca*), Gadwall (*Anas strepera*), Eurasian Wigeon (*Anas Penelope*), Mallard (*Anas platyrhynchos*),

1 Rohtak District Gazetteer, 1910, p.8

Northern Shoveller (*Anas clypeata*), Common Pochard (*Aythya farina*), etc. The resident wetland birds are Spot-billed Duck (*Anas poecilohyncha*), Little Grebe (*Tachybaptus ruficollis*), Little Cormorant (*Phalacrocorax niger*), Large Cormorant (*Phalacrocorax carbo*), Little Egret (*Egretta garzetta*), Large Egret (*Casmerodius albus*), Cattle Egret (*Bubulcus ibis*), Indian Pond-Heron (*Ardeola grayii*), Indian Moorhen (*Gallinula chloropus*), Purple Moorhen (*Porphyrio porphyrio*), Black-winged Stilt (*Himantopus himantopus*), White-throated Kingfisher (*Halcyon smyrnensis*), etc. The geese found in the district are also of three species, viz. grey lag, bar-headed and large white-fronted. Ducks and geese are found in the *jhils* and ponds of villages Bakhtawarpur (Raiya), Dawala, Bakra and Dharana.

The rare birds namely, the Painted Stork (*Mycteria leucocephala*) (listed as Near Threatened by International Union for Conservation of Nature, 2007), the Asian Openbill (*Anastomus oscitans*), and the Oriented White Ibis (*Threskiornis melanocephalus*) are also found in the district.

Game Birds.— The common game birds found in the district are Black Francolin (Kala Teetar), *Francolinus francolinus*; Grey Francolin (Bhura Teetar), *Francolinus pondicerianus*; Indian Peafowl (Mor), *Pavo cristatus*; Quails; Blue Rock Pigeon (Kabutar), *Columba Livia*; Little Brown Dove, *Streptopelia senegalensis*; and Eurasian Collared-Dove, *Streptopelia decaocto*.

Scavenger and Predator Birds.— The common scavengers are Black Kite (*Milvus migrans*), Egyptian 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 Egyptian and White-backed vultures, both these species have recently been listed as 'Endangered' and 'Critical', respectively, by International Union for Conservation of Nature, 2007)

While the predators like Black-shouldered Kite (*Elanus caeruleus*), Tawny Eagle (*Aquila rapax*), Shikra (*Accipiter badius*), and Spotted Owlet (*Athene brama*), etc., keep a check on the populations of their prey species like rodent and insects pests.

Colourful Birds.— The colourful birds commonly seen are Peafowl (*Pavo cristatus*-the National Bird of India), Indian Roller (*Coracian 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*), Koel (*Eudynamys scolopacea*), Kingfishers such as Common Kingfisher (*Alcedo atthis*), White-breasted Kingfisher (*Hacyon smynrensis*), Red-vented Bulbul (*Pycnonotus cafer*), Purple Sunbir (*Nectarinia asiatica*), etc.

Other common birds are House Sparrow (*Passes domesticus*), Oriental Magpie-Robin (*copsychus saularis*), Indian Robin (*Saxicoloides fulicata*), Pied Bushchat (*Saxicola caprata*), Indian Chat (*Cercomela fusca*), Common Babbler (*Turdoides caudatus*), Jungle Babbler (*Turdoides striatus*), Lesser Golden-backed Woodpecker (*Dinopium benghalense*), Ashy Prinia (*Prinia socialis*), Plain Prinia (*Prinia inornata*), Common Tailorbird (*Orthotomus sutorius*), Black Drongo (*Dicrurus macrocercus*), Brahminy Starling (*Sturnus pagodarum*), Rosy Starling (*Sturnus roseus*), Asian Pied Starling (*Sturnus contra*), Common Myna (*Acridotheres tristics*), Bank Myna (*Acridotheres ginginanus*), and Baya Weaver (*Ploceus phillipinus*), etc. Common Sand-grouse is found in open, barren plains, stubble fields and land away from the water. It comes to drink water regularly in the morning and at the sunset. It is found at Salhawas in the district.

3. REPTILES

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

(a) SNAKES

(i) Non-poisonous Snakes

Indian Python or Rock Python (*Python morulus*).— The colour pattern is whitish or yellowish with the blotched patterns varying from shades of tan to dark brown. This varies with terrain and habitat. This occurs in a wide range of habitats, including grasslands, swamps,

marshes, rocky foothills. The adult average length is 3000 mm or 118 inch and the maximum length is 7620 mm or 300 inch. The species is thick bodied, smooth-scaled having head broader than neck. The body has yellowish to brown with asymmetrical dark brown, black edged blotches. Underside is white or yellowish. This species is killed for its skin demand in the market.

Red Sand Boa or John's Sand Boa (*Eryx johni*).— The adults rarely exceed 2 feet or 61 cm in total length although sometimes they reach 3 feet or 91 cm. The body is cylindrical in shape with small polished dorsal scales. The tail, which is blunt, rounded, and not distinct from the body, appears truncated. The head is with a wide, shovel-shaped scale at the snout but not broader than neck. Eye is with vertical pupil. Colouration varies from reddish-brown to dull yellow-tan. Belly is white spotted with brown or sometimes entirely brown.

Indian Rat Snake or Dhaman (*Ptyas mucosus*).— They are wary, quick to react, and fast-moving reptiles. Their maximum length is 3500 mm or 138 inch. They inhabit forest floors, wetlands, rice paddies, farmland, and suburban areas where they prey upon small reptiles, amphibians, birds, and mammals. Their colour varies from pale yellow, olive brown, gray or black. Eyes are large and body is light. Underside often has prominent dark crossbars.

Checkered Keelback (*Xenochrophis piscator*).— Maximum length is 175mm or 69 inch. This snake's eyes are rather small, and shorter than its distance from the nostril in the adult. The frontal scale is longer than its distance from the end of the snout. Colouration is very variable, consisting of dark spots arranged quincuncially and often separated by a whitish network, or of black longitudinal bands on a pale ground, or of dark cross bands, with or without whitish spots. Two oblique black streaks, one below and the other behind the eye, are nearly constant. Other parts are white, with or without black margins to the shields. During rains, these are often killed on roads probably due to their diurnal habits.

(ii) Poisonous Snakes

Common Indian Krait (*Bungarus caeruleus*).— The average length of this venomous snake is 0.9 m (3.0 ft), but it can grow to 1.75 m (5 ft 9 in). Males are longer with longer tails. The head is flat and the neck is hardly evident. The body is cylindrical, tapering towards the tail. The tail is short and rounded. The eyes are rather small, with rounded pupils, indistinguishable in life. 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 snakes eat other snakes (even Kraits), sometimes eat rodents, lizards, and frogs.

Spectacled Cobra or Binoocelate Cobra or Binpcellate Cobra (*Naja naja*).— The Indian Cobra varies tremendously in colour and pattern throughout its range. The vental scales underside colouration of this species can be grey, yellow, tan, brown, reddish, or black. Dorsal scales of the Indian cobra may have a hood mark or colour patterns. Length of an adult snake is 1000 mm or 39 inches, and maximum is 2200 mm or 87 inches. This cobra species can easily be identified by its relatively large and quite impressive hood, which it expands when threatened. It is found in various shades of brown, yellow, grey, or black. The cobra's dramatic threat posture makes for a unique spectacle as it appears to sway to the tune of a snake charmer's flute.

Russell's Viper or Daboia (*Vipera russelli*).— This snake can grow to a maximum total length i.e. body with tail of 166 cm or 5.5 ft and average is about 120 cm 4 ft. It is more slenderly built than most other vipers. The head is flattened, triangular, and distinct from the neck. The snout is blunt, rounded and raised and the nostrils are large. Eye has vertical pupil. Tail is short and thin. Two dark triangular streaks are behind and below eye. It is most common in plains particularly in highly urbanized areas and settlements. It eats rats, rodents, lizards, etc.

(b) LIZARDS

Yellow Bellied House Gecko (*Hemidactylus flaviviridis*).— The common

gecko is pale-grey or greenish-grey, brown or olive dorsum and back is with wavy, dark cross bands, which are clearly visible during the day; The belly is yellowish. This reptile standard length is 42-90 mm and tail length is 38-90 mm. Head is large with a board snout and is covered with minute granules. 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 short and is almost equal to the head and body.

Indian Garden Lizard (*Calotes versicolour*).— Their standard length is 86-129 mm and tail length is 300-350 mm. The body is compressed, dorsal colour light-brown grayish, dark streak from eyes; head is large, inflamed at angle of jaws in males; eye are large; males with gular sac; limbs long well developed; digits long, slender, slightly compresses tangentially, strongly clawed; tail almost round and slender. 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 than the other; gular sac not developed. It has 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.

(c) TORTOISES AND TURTLES: Only one species of turtles is known to occur in the district which is described below:-

North Indian Flap-shelled Turtle (*Lissemys punctata*).— The "flap-shelled" name stems from the presence of femoral flaps located on the plastron. These flaps of skin cover the limbs when they retract into the shell. A small flat turtle maximum length is 24 cm, with head, which is moderately large, the snout is short and broad, and its length is less than the length of the eye opening. Carapace is gray-green, with numerous black-bordered yellow spots, irregularly arranged and with a light yellow marginal rim. Carapace and plastron features: the carapace and plastrons covered by a continuous

sheet of soft skin and their callosities are finely granulated. The lateral and the hinder portions of the carapace are most flexible. Plastron is with soft, semicircular flaps. The hind feet can be totally concealed in plastron. Tail is very short. The subspecies prefers to live in shallow muddy ditches, lakes, and marshes. It is a carnivorous turtle and feeds mainly on frogs, fishes, shrimps, and snails. It lays 12 eggs in a single clutch. It is suspected to be threatened on account of ruthless killing and overexploitation of adults and their eggs for protein-rich food. Major threats are habitat destructions predation by jackals and dogs; construction of hydroelectric dams and barrages. Status. IW(P)A 1972 Schedule I.

4. AMPHIBIA

The amphibian fauna mainly comprises of frogs and toads.

(a) FROGS: The four species of frogs are known to occur in the district which are as follows:-

Skittering Frog (Euphlyctis cyanophlyctis).— Adults olive to dark brown; dorsal region with dark spots and a cream coloured band along each flank. Well marked spots on the limbs. Lower parts; white, cream, marbled or spotted, ornamentation in lower part sometimes transforming into a reticulum. Skin with small tubercles and warts on back; a strong fold from posterior corner of eye to shoulder present; lower parts smooth. In some specimens, there are porous warts or glands surrounding thoracic region in a girdle and continue laterally along each side of the belly. *Cyano* means blue, the name of the species is from blue vocal sacs. Head moderate and depressed. Snout pointed, tip slightly acuminate. Canthus rostralis distinct. Loreal region oblique with concavity. Nostrils are nearer to tip of snout. Internarial distance is greater than interobital distance. Forelimbs moderate with obtusely pointed fingers. Subarticular tubercles are small. Palmer tubercles also less developed. All fingers are almost of equal thickness. Tips of toes are swollen into small knob like structure. The web in between toes is very extensive. The fourth toe is the longest. Subarticular tubercles are small and feeble. A distinct dermal fringe on the outer aspect of fifth toe is present. Inner metatarsal tubercle

small, pointed. There is no outer tubercle.

Southern Cricket Frog (*Fejervarya synadrensis*).— Light grey to brownish, small sized frogs, head as long as wide or slightly longer, arrow shaped; snout obtusely pointed and projecting beyond lower jaw, nostrils near the snout, eyes large, equal to length of snout, interorbital width equals height of upper eyelid; tympanum distinct, nearly half in ocular diameter; a strong supratemporal fold from eye to tympanum and shoulder; first finger longer than second; subarticular tubercles of the fingers prominent, the metacarpal tubercles at the base of the palm; hind limbs short; tibia slighly longer than femur, toes half webbed.

Indian Bull Frog (*Hoplobatrachus tigerina*).— Juveniles brillantly green and yellow coloured with a distinct yellow vertebral streak. Another yellow oblique band starts from shoulder and continues up to belly as a laterlal band. In adults, lateral band fades and turns white. A dark canthal steak is present. Limbs with bold patches of dark olive colour. Hinder part of thigh marbled with black and yellow. Lower parts white, immaculate; occasional specimens with a blotched throat. Males with two lateral vocal sacs of bright blue colour on each side of throat. Fore limbs moderately thickened. A strong nuptial pad on the inner side of metacarpal region of first finger. Snout pointed, head moderate. Tip of snout projecting beyond lower jaw. Head broader than long, head width 1.05-1.13 times in the length. Length of snout longer than eye, length of snout 1.63-1.82 times of eye diameter. Canthus rostralis obtuse; loreal region oblique with convavity on middle. Nostrils always nearer to tip of snout than anterior corner of eye. Interobital space narrow than upper eyelid. Tympanum distinct, two-third diameter of eye, 1.5 to 2.5 times its distance from the latter. Skin of upper parts smooth with elongated prominent longitudinal glandular folds, which are interrupted throughout the entire dorsum. A strong glandular fold from eye to shoulder. Lower parts smooth. Anal region warty. Limbs with rough warts. Eyes elevated well beyond skull. Vomerine teeth strong, obliquely placed rows in between choanae: tooth bands close to each other than to choanae. In some specimens, vomerine teeth extend beyond posterior margine of

choanae. Lower jaw with two very prominent notches at symphysial zone which fits into upper jaw. Toes obtuse, somewhat swollen at the tip. Metatarsals separated nearly to base, subarticular tubercles distinct but comparatively smaller in dimension. Inner metatarsal tubercle distinct, blunt, elongated, its length 1.25 to 2.00 times in length of inner toe. Outer metatarsal tubercle absent. A flap of skin on outer aspect of fifth toe present. The breeding calls of male are signal of onset of monsoon for villagers of plains. During breeding season, males are very active in pools fed by rainwater. The over exploitation of the species for its leg has caused the threat to the survival of the species. This frog is more active at night.

Ornate-narrow mouthed Frog (*Microhlya ornate*).— The species is brilliant in colour. A reddish brown well defined dark streak commences behind the eyes and extends from shoulder to flank. The characteristic colour pattern, a dorsomedian dark patch, begins at about mid level of eyes, narrows slightly on the occiput, then widens a little finally spreading on to the sacral region. Limbs cross barred. Anterior portion of thigh and anal region darker. Lower surface cream coloured in life but transformed into white after preservation. The small tubercles present throughout dorsal region of body and limbs (red in life and white spotted in preserved condition). Snout obtusely pointed, projecting beyond lower jaw. Maximum diameter of eye equals length of snout. Head narrower than body and longer than wide. Nostrils nearer tip of snout than anterior corner of eye. Canthus rostralis obtuse, straight. Loreal region vertical. Tympanum hidder under skin. Tongue oval, entire. Jaws toothless. Forelegs short and slender. First finger much shorter than second. Two elongated palmer tubercles. Terminal portion of all fingers swollen into a small round knob on ventral aspect. Hind legs comparatively robust than fore legs. Tip of toes similar to those of fingers. Toes with rudiment of web at the base, subarticular tubercles distinct. Two metatarsal tubercles, inner one elongated, outer small and round. Ventral surface smooth. Posterior portion of thigh near and region covered with densely set tubercles. They are nocturnal in habit. They conceal themselves under

logs, stones, leaf-litters and crevices of river beds. The male emits an amazingly high pitch sound which seems unbelievable for a small creature. The ventral surface of males is densely pigmented, whereas females exhibit scattered pigmentation.

(b) TOADS: Only one species of toads is known to occur in the district which is described below:-

Common Indian Toad (*Duttaphrynus melanostictus*).— Usually dark brown above, sometimes limbs crossbarred, ventral surface immaculate or more or less spotted or with a network of brown colour. The tips of dorsal glands are tubercular, sometimes with black spines. Snout short, inter-orbital space much broader than upper eyelid. Head with elevated bony ridges, *viz*. Canthal ridge along canthus rostralis, a supraorbital ridge along inner edge of upper eyelid, which may continue into preorbital and postorbital ridges and slightly backwards into a parietal ridge and a supratympanic ridge. Crown of head deeply concave. Canthus rostralis angular. Loreal region slightly oblique, nearly flat. Nostrils nearer to tip of snout than to anterior corner of eye. Tympanum more than half diameter of eye, nearer to eye. A double series of round cornified large warts present on both side of vertebral line, connecting from cranio-vertebral joints to sacral zone. Parotoids moderate and elongated. The tubercles, the parotoids, the ridges on the head, the maxillary edges, and the tip of fingers and toes often with dark brown cornified substances. Granular on ventral side. Hind limbs short. Tips of toes obtuse. The web in between toes thick. Upper parts densely covered with more or less prominent, often spinous warts and tubercles of various sizes.

5. FISH

Fishes act as bio-indicator of the environment of particular ecosystem. The fish fauna of Jhajjar district shows its diversity mainly due to village ponds (*Jhors* as called locally) and lakes. The main attraction of the district is a man-made Bindawas lake used for storage of the excess waters of the Jawaharlal Nehru Canal. The common fishes are: Rohu (*Labeo rohita*), Bata (*Labeo bata*), Dolla (*Channa spp*.), Spotted Snakehead (*Ophicocephalus punctatus*), Striped

Mystus (*Mystus vittatus*), Mullee (*Wallago attu*), Gobi (*Glossogobius girius*), Baam (*Mastacemblus armatus*), Fire-fin Barb (*Puntius ticto*), Spot-fin Barb (*Puntius saphore*), Rosy Barb (*Puntius conchonius*), Flying Barb (*Esomus danricus*), Freshwater Garfish (*Xenetodon cancila*), Chiri (*Badis badis*), etc.

(B) INVERTEBRATES

The main lower animals groups existing in the districts 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), Hermiptera (Bugs, etc.), Diptera (Flies, Mosquitoes, etc.), Hymenopterra (Bees, Wasps, etc.), Coleoptera (Beetles), and Lepidoptera (Butterflies). The butterflies are the most beautiful insects, easily recognisable 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 in the district Jhajjar 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 Band 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 Parrot (*Castalius rosimon*), Pea Blue (*Lampides boeticus*), Large Hedge Blue (*Celastrina huegelii*), Pale Grass Blue (*Pseudozizeeria maha*), etc.

TOPOGRAPHY

Jhajjar district lies at the confluence of Indo-Gangetic Plain of the north

east and sandy or *bangar* tract of west and Aravalli Offshoots of south. Altitude of the district ranges from 212 metre to 276 metre above mean sea level (MSL). It has varied topography ranging from sandy tracts, alluvial plains and remnants of Aravali offshoots. Topographically, the district may be divided broadly into three units:-

i) North Eastern Upland Plain— It is spread in the north-eastern part of the district like Beri, Madana Kalan, etc. It slopes towards south. This plain is covered with old alluvium of high productivity. Upland Plains are known as new alluvium or *khaddar*.

ii) Jhajjar Lowland— Jhajjar lowland has variable slope tendencies and resultant topographic differences. This topographic variation is responsible for the formation of troughs like depressions in south-eastern part of the district

iii) The Sandy Region— It is spread in southern and southern-western parts of the district. It comprises of permanent sand dunes, most of them have been levelled like Matanhail and Salhawas.

The last two topographic regions are different from the upland plain of the north as in these regions land slope from south to north. They start with the elevation of about 800 feet in south to 710 feet above sea level in the north near Jhajjar town.

RIVERS, DRAINAGE AND CANALS

There is no perennial or seasonal source of water in the district. The only stream which entered the district was Sahibi *nadi*. The ephemeral Sahibi originates from the eastern slopes of Salwar Protected Forest hills, which are the remnants of the Aravali mountain system. Contrary to the fact every other river originating in Aravali mountains flows to south, Sahibi flows in north as an exception to the established pattern of drainage there. In the past, Sahibi used to enter the south-eastern corner of Jhajjar tehsil near Lohari village. Maintaining its flow, it crossed through that corner of Jhajjar tehsil, passed through the north western part of Gurgaon district and finally re-entered Jhajjar tehsil near Kutani[1].

1 Rohtak District Gazetteer, 1970, pp.6-7

Earliest courses of the Yamuna show the apparent link with the dying traces of Sahibi, indicative of her being once the tributaries of Yamuna river. The sudden and fast migration of the perennial Yamuna resulted in the profile equilibrium with its seasonal tributaries namely Sahibi and Banganga. These tributaries could not cope with pace of main river migration and thus were forced to abandon their waters in the older flood plains of Yamuna inundating a vast area around the district in the past.

Experience shows that due to its long passage through the dry and sandy counts, Sahibi had been in spate in years of exceptional heavy rainfall, and caused flooding but, remained dry for the rest of the year. To moderate these floods, a barrage has been constructed near Masani village (Rewari). As such, it had stopped flowing into Jhajjar district for the past over a decade. Further, the district is encircled by a flood protection bundh from three sides to serve as a physical barrier for its horizontal expansion towards northern, western and southern sides. Various drains and pump houses were constructed for dewatering of flood water.

The district area falls in Yamuna sub-basin of Ganga basin, and is mainly drained by the Drain No.8 which flows from north to south. This drain passes through the district and is linked with Bhindawas lake through Bhindawas Link Drain. It is the main drain passing through the district, carries flood waters through its outfall drain into the Najafgarh drain which is the northern end river Sahibi that continues its flows through Delhi where it is channelized and then empties itself in Yamuna. Jawahar Lal Nehru feeder and Bhalaut sub branch are main canals of the district. Besides these, there are some other water bodies adjoining the identified roads, in the form of village ponds and lakes which act as water reservoirs.

CLIMATE

Climate of the district is sub-tropical, semiarid, continental and monsoon type. It is characterized by the dryness of the air with an intensely hot summer and a cold winter. Only during the south-west monsoon months from last week of June to September, moist air of oceanic region penetrates into this district and causes high humidity, cloudiness and monsoon rainfall. The year may be divided into four seasons. The cold season starts by last November and extends to the middle

of March. This is followed by the hot season which continues to about the last week of June when the southwest monsoon arrives over the district. The south west monsoon season falls during July to September. The post monsoon months October and November constitute a transition period between the monsoon and winter conditions.

Rainfall.— Records of rainfall in the district are available for five rain-gauge stations for period ranging from 31 to 43 years. In fifty years period from 1961 to 2010, the rainfall was less than 80 percent of the normal in 12 years and one occasion of four consecutive years of such a low rainfall occurred during this period. The annual rainfall was between 301 mm and 600 mm in 22 years out of 36 years**.** The average annual rainfall in the district is 486.7mm. The rainfall in the southwest monsoon season constitutes about 86% of the annual normal rainfall, July and August being the rainiest months with an average rainfall of about 158 mm. There is large variation in the annual rainfall from year to year. In this fifty years period, the highest annual rainfall was recorded in 1977 when it amounted to 207 percent of the normal and the lowest annual rainfall in the district was in 1989 when it amounted to 41 percent of the normal. The details of rainfall at these stations and for the district as a whole are given in Tables II and III.

On an average there are 24 rainy days (i,e. days with rainfall of 2.5 mm or more) in a year in the district. This number varies from 18 rainy days at Salhawas to 31 rainy days at Jhajjar. The heaviest rainfall in 24 hours at any station in the district was 325.1 mm at Jhajjar on 19th September, 1933; followed by 279.4mm at Beri on the same day; 256.5mm at Salhawas on 29th September, 1911; 188.6mm at Bahadurgarh on 6th August, 1977 and 160mm at Dujana on 13th August, 1963, the details of which may be seen in Table III. In recent years, the highest annual average rainfall has been reported as 549.2 mm during 2016. Monthly Average Rainfall for years 2011 to 2018; Monthly Normal Rainfall Average of 5 years from 2014-2018; and Average Annual Rainfall of the district from 2008 to 2018 may be seen at Tables IV, V and VI, respectively, of the Appendix.

Temperature.— There is no meteorological observatory in the district. So the description that follows is based on the records of the observatories situated in the neighbouring Bhiwani and Gurgaon districts. The cold season starts towards the

latter half of November when both day and night temperatures decrease rapidly with the advance of the season. December and January are the coldest months when the mean maximum temperature is at about 21°C and the mean minimum temperature is about 7°C. In winter months, during cold waves which affect the district in the wake of western disturbances passing across northern region of India, minimum temperatures may sometimes go down to the freezing point of water and sometimes frosts also occur. From the middle of March, temperature begins to rise rapidly. May and June are the hottest months with the mean maximum temperature more than 40°C and the mean minimum temperature at about 26°C. Air is generally dry while hot desiccating winds known as "Loo" and dust storms are common in summer. Heat is intense till the onset of the monsoon. During this period, weather becomes oppressive. In May and June, the maximum temperatures may sometimes reach about 47°C on individual days. With the advance of the southwest monsoon into the district towards the end of June, day temperatures drop appreciably while night temperatures continue to be as high as in summer. Even during the brief southwest monsoon the weather is uncomfortable in between the spells of rain on account of increased moisture in the air. In October, day temperature is as high as during the monsoon months but nights are cooler.

Humidity.— The air is generally dry during the greater part of the year in the afternoons. In the south-west monsoon and winter months, humidity is high in the mornings when its values are about 70 percent to 85 percent. Months of April and May constitute the driest part of the year when values of humidity are about 48 percent in the mornings and about 30 percent in the evenings.

Cloudiness.— During the monsoon season, particularly in July and August, skies are heavily clouded or overcast. In the rest of the year, skies are generally clear or lightly clouded. In January, February and early March, sky becomes cloudy and sometimes overcasts in association with the 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. In winter and pre-monsoon season, winds blow mostly from northwest direction. However, on some days winds blow from south-west, west and southeast directions. Winds are predominantly northwesterly, southeasterly and southwesterly in the monsoon

season. In the post monsoon months winds are mostly from northwest and southwest directions in the mornings and from northwest direction in the afternoons.

Special Weather Phenomena.— Thunderstorms occasionally occur throughout the year. Its frequency is more during April to August and or less in November and December. Dust storms locally known "*Andhis*" are generally noticed in March to July. Violent squalls often accompany such storms and often precede thunderstorms. Some of the thunderstorms do not give any appreciable rain, but other are accompanied with heavy rain and occasionally with hail. Rain during the monsoon months is often accompanied with thunder. In the winter months, thunderstorms also occur in association with western disturbances. Fog occurs in the winter and post-monsoon months.

Seismicity.— In the seismic zoning map of India, prepared under the auspices of Bureau of Indian Standards (BIS code IS 1893: Part I 2002), the area of Jhajjar district lies in Seismic Zone-IV. Broadly, Seismic Zone-IV is associated with seismic intensity of VIII on Modified Mercalli Intensity (MMI) scale.

The prominent tectonic feature of Jhajjar district is Mahendragarh Dehradun Sub-Surface Fault (MDSSF) that passes through it. Other main tectonic features in the proximity of the district are: Chahapoli Fault, Kanthi Fault, Jaipur Depression, Bharatpur Depression, Great Boundary Fault, and Delhi-Sarghoda Ridge, etc. In addition, the Main Boundary Thrust (MBT) and Main Frontal Thrust (MFT) of Himalayas region having potential of generating moderate to great earthquakes are also not far from the district.

Historically and instrumentally, recorded data on earthquakes shows that the area of Jhajjar district lies in a region affected by slight to moderate earthquakes in the past, and the district and its environs have been affected by earthquakes of peninsular domain (historical earthquake of Delhi, M:6.5, 1720; Mathura earthquake, M:6.8, 1803; Bulandshahar earthquake, M:6.7, 1956; and Faridabad earthquake, M:6.0, 1960). In addition, the district and adjoining areas have also been affected by earthquakes from far field seismic source in the Himalaya (the Great Kangra earthquake, M:8.0, 4th April, 1905: the Uttarkashi

earthquake, M:6.6, 20th October, 1991 and Chamoli earthquake, M:6.8, 29th March, 1999). As per records available from India Meteorological Department, about 37 significant earthquakes with magnitude more than or equal to 3 (M: ≥3) have occurred in this region during the period from 1976 to 2018. List of these earthquakes is placed at Table VII of the Appendix.

Presently, there is no scientific technique available anywhere in the world to predict the occurrence of earthquakes with reasonable degree of accuracy with regard to space, time, and magnitude. It is, therefore, suggested that appropriate steps may be taken to ensure that the dwellings and other structures in the region that are designed and constructed as per guidelines of Bureau of Indian Standards (BIS) and other agencies like National Disaster Management Authority (NDMA) and the State Disaster Management Authority (SDMA) to minimize the losses caused by earthquakes. The choice of seismic factor to be adopted for designing and engineering the structures depends on horizontal ground acceleration and various other factors including type of structures, the ground conditions, and also importance of structures. For important and critical structures, site specific spectral studies have to be carried out before assessing the seismic design parameters.

GROUND WATER

The ground water in the area occurs in the alluvium of Quaternary age, and the permeable granular zones comprise of fine to medium sand and occasionally coarse grained sand and gravel. Their lateral as well as vertical extent is limited. The study of borehole data generated by the Central Ground Water Board indicates that clay group of formations dominate over the sand group in the district. In general, source of ground water in the area is rainfall, subsurface inflow, seepage from canal and return seepage from irrigation. The natural discharge includes sub-surface out flow and evapo-transpiration. The artificial discharge includes utilization of groundwater for irrigation, domestic and industrial purposes. Granular zones that occur are inter-bedded with clays in alluvial formations form the principal ground water reservoir. The upper surface of zone of saturation is represented by water levels in dug wells. Groundwater in the area occurs under

water table and semi-confined or confined conditions. Two to four permeable granular zones with an aggregate thickness varying between 23m and 50m have been encountered down to the depth of bed rock. At Bahu site in depth range of 74m to 116m, transmissivity value 124m²/day and lateral Hydraulic Conductivity 731m/day were determined. There are 16 national hydrograph network stations in the district[1].

The depth to water level varies from 0.62 meter to 11.68 meters below ground level during pre-monsoon period, and 0.40 meter to 11.60 meters below ground level during post-monsoon period. The long term (10 years) trend of water level suggests that water level is rising at the rate of about 0.004 meter to 0.49 meters per year. There is, however, a fall in parts of the district which is in the order of 0.005 meter per year. In the extreme southwest area of the district where the water level are deep ranges > 9.00 mbgl, high fluctuation from 2 meter to 3 meter, was observed due to excess rainfall in 1994 (709mm), 1995 (905mm) and 1996 (697mm). There is good correlation between rainfall and water level fluctuation which is worked out to be 0.86. About 75 percent of the variation in water level is accounted by rainfall. The net work of canals is causing water logging condition in the area.

The elevation of the water table in the district varies from 206 meters to 250 meters above mean sea level. The average gradient of the water table was of the order of 0.48 meter per km. The general slope of water table in the area is converging towards the centre of the district or more precisely around Jhajjar. It is also observed that the flow of water in the western part of the district is towards south- west to north- east and south-east to north-west.

Ground Water Resources.— The block-wise ground water resource potential in the district has been assessed as per Ground Estimation Committee-1997 as on 31st March, 2013. The stage of Ground Water development ranges between 69 percent (Block Salhawas) to 89 percent (Block Bahadurgarh and Beri). Net Annual Ground Water Availability is 42,462 hectare metre (Ham) and existing gross ground Water Draft for irrigation is 35,297 Ham in 2012-13. Net ground water

1 Ground Water Information Booklet, Jhajjar District, Central Ground Water Board, 2013

availability for future irrigation development is 7,239 Ham. The stage of ground water development in the district is 83 percent. As per Ground water estimation on 31st March, 2011, the ground water development in all the blocks has exceeded the available recharge and thus Jhajjar and Salhawas have been categorized as "over exploited", Bahadurgarh as "critical", while Beri and Matanhail as "semi-critical".

Ground Water Quality.— The ground water of the district is alkaline in nature. The power of hydrogen (pH) values ranges from 7.42 pH to 8.93 pH indicating that the ground water is neutral to alkaline (weak base type in nature). In some parts of the district below a relatively thin layer of fresh ground water in dug well zone, the quality deteriorates with depth and as such areas may not always be suitable for installation of shallow tube wells.

The electrical conductivity is a measure of total dissolved solids present in water and it ranges from 621 to 15500 micro/mhos at 25°C was observed in Dighal. The nitrate values within the permissible limit are at few places such as Kulasi, Dubaldhan, Mundsa, Chhuchakwas, Wazirpur, Chhara, Dulhera and Salhawas. The highest value of nitrate was recorded at Dighal (1755 mg/l). The fluoride (F) values ranges from 0.12 mg/ l to 2.89 mgl but in general it is within the permissible limit except at Mundsa, Subana, Gubhana and Chamanpura in the district. Highest value of fluoride was observed at Chhuchhakwas (2.89 mg/l). Ground water occurring in the shallow aquifer is by and large saline, but where the EC, NO3, and F value are within the permissible limits set by the BIS: 10500: 1991, it is suitable in the district for drinking purposes, however potable water at places along canals and surface water bodies like ponds, where salinity has decreased, is collected for drinking purposes. According to study conducted by Yadav and Lata (2003) in Jhajjar district has reported that fluoride content was higher than 2.0 mg per litre in all the blocks of this district. As per USSL diagram ground water fall under C, S, C2S1, C3S1, CS2, C4S1, C4S2, C2S3, and C4S4. The deep ground water is saline, salinity increases with depth and that water is not fit for irrigation. In a very small patch in the extreme southwest of Jhajjar approximately 50 to 60m thickness of granular zones (with in 80m depth) bearing fresh water has been identified. The shallow ground water is of NaHCO3 type, and mixed facies type of water also occurs in the district.

Ground Water Development Status.— The ground water is saline at the shallow as well as at depths in the area. The water supply, rural or urban in the district area is based only on canal water. The additional demand of water both in rural and urban areas are met with the hand pumps generally located near the canals or other surface water bodies, as the quality of shallow ground water is fresh. The ground water being saline at depth; the shallow ground water can be developed for moderate supplies for irrigation purposes.

Water Logging.— Water logging results when there is an excess recharge over discharge from the phreatic aquifer over a period of time till progressively the increase in storage raises the water table to near surface. Before the introduction of the canal system, farmers used to have open wells where the water salinity was less at shallow depth but with the availability of canal water in plenty, these open wells abandoned, thus reducing the pumping to zero level practically. Thus, canal system is responsible for existing water logging condition and soil salinization due to rising water table of saline water. The area under water logging (DTW 0 to 2m below ground level) is 297 square kilometres, forming about 16 percent of the district. Water logging can be controlled by adopting suitable measures to reduce recharge and increase the discharge from the phreatic aquifer in the problem area. Shallow tube wells should be constructed along the canals and in the water logged areas. The tube wells so constructed along the canals will not only increase the draft in the area but will also augment canal water supply which can be utilized at the tail ends. Plantation of Eucalyptus and other similar type of plants along the minors in the command area and strengthening of present drainage system would also be beneficial in arresting the water logging in the area. Salinity the twin problem of water logging and salinity is associated with clay formation at shallow depth, thereby the increased evaporation and evapo-transpiration from shallow water table takes place. Change in cropping pattern (Crop diversification) from high water intensive crops to low water intensive crops such as maize, wheat and pulses may reduce water logging.

The improper management of ground water by users in the area has also contributed to ground water salinity. This has also damaged surface soils in the area and aggravated the problem of ground water salinity. In absence of natural

drainage, the rain water accumulates in the natural depressions and artificial drains. This undrained flood water creates ponds and marshes. However, a good net work of artificial drains keep proper balance between soil moisture and air to a considerable extent, and has been very helpful in removing excess water and salt from the soils. Fluoride High fluoride (F) content, more than the permissible limit of 1.5mg/l, is present at places in the shallow ground water in the district. The high fluoride values ranges from 0.12mg/l to 2.89 mg/l, thus making the water harmful for human consumption.

Ground Water Problems.— The south-west and north-west parts of Jhajjar town including surrounding areas in these directions are heavily prone to floods due to existence of saucer like depression, rain water accumulates in aforesaid depressions/low lying areas. The twin problem of water logging and salinity is also associated with clay formation at shallow depth, thereby the increased evaporation and evapo-transpiration from shallow water table takes place. In the absence of natural drainage, the rain water accumulates in the natural depressions and artificial drains. This undrained flood water creates ponds and marshes. However, a good network of artificial drains keeps proper balance between soil moisture and air to a considerable extent, and has been very helpful in removing excess water and salt from the soils.

Availability of potable underground water.— Availability of good quality of surface or ground water is essential for the expansion of agriculture, industry, as well as urbanization. However, in Jhajjar town, by and large quality of ground water is brackish. The surface water is also limited to its source which lies outside the state. It is, therefore, imperative to provide canal based water supply to the town.
