CHAPTER IV

AGRICULTURE AND IRRIGATION

INTRODUCTION

Agriculture was the most important occupation of the people of the district before the Aryans inhabited this area in the second millennium B.C. The archaeological evidence reveals that agriculture was being practiced in this region earlier than the Harappan culture; the earliest literary reference is found in the *Vaman Puran.* In the *Vedas*, it is also mentioned that land was laid out into regular fields ploughed and sown; the crops were reaped and stored. Here, the system implies individual ownership, "in which wide fields, vast treasures, spacious pastures, has Indra bestowed in his friends". Katyayan in his *Vartik* and Pantanjali in his *Mahabhashya* described that the word '*Krishi*' included not only the tilling or ploughing the land but also other operations like sowing, reaping, and feeding the cows and bullocks etc.[1] During the *Mahabharata* time, this region was a part of Kuru's *Janpada.* The King Kuru launched an ambitious plan to reclaim that vast region of the Saraswati Valley for agriculture purposes in order to strengthen their economy and political power. The land of Kuru reached the pinnacle of glory during the Mahabharata time as agriculture was given prime importance.

The people of this region went on sowing and reaping crops while imperial movements swelled from the east and invasions from the north-west. The Empire of Mauryan Dynasty of Magadha touched the Ganga-Yamuna fertile plains. The Greek historian Arrian writes, "it was reported that the country beyond the Hyphasis (Beas) was exceedingly fertile, and that the inhabitants were good agriculturists". Banabhatta, the court poet of Harshavardhana and Huan Tsang, the Chinese traveller, have given a graphic description of its agriculture developments and allied occupations. Huan Tsang, in his work *Si-Yu-Ki,* quoted, "the soil was rich and fertile and the crops were abundant, the climate was warm, the manner and the customs of the people were liberal".[2]

During the Medieval period in Panipat along with the other parts of Haryana region, in spite of agriculture development in the form of land reforms, irrigation works and the establishment of a pyramidal structure in the agrarian relations, the farming methods remained almost the same as there was hardly any progress in science and technology related to agriculture. During

this period, an aphorism in the early days was that the troops and the peasants are the two arms of kings. The farmers and the revenue officials who held land for the maintenance of troops under their command came into existence and became powerful. Thus, the *Jagirdari* system came into existence which exploited the cultivators. Sometimes, revenue taxes were too high and farmers were exploited on many fronts. Their economic condition continued to deteriorate in the British period due to the high payment of revenue levied by the Government and atrocities committed by the *Jagirdar*s. The British land settlements are said to have ruined the peasantry in Haryana region. The poor farmers, who could not afford to pay the revenue, had to go to *zail.* In the *pargana* of Karnal, to escape such oppression, the inhabitants of some villages, nearly en masse, had abandoned their lands and homes.

After independence, there have been considerable changes in almost all the perimeters of agriculture in India. In order to meet the growing demand for food for the teaming millions, agriculture has been intensified on the one hand and on the other, attempts have been made to bring more and more areas under cultivation. The land reform measures were also taken with the main objective of abolition of mediatory system between the State and the tiller; security of tenure, confirmation of the ownership to the cultivator of land to the tiller, imposition of ceiling on the agriculture land holdings and consolidation of land holdings for the application of modern techniques in the agriculture.

In fact, even after independence, the region of Haryana as a part of the erstwhile State of Punjab remained backward owing to neglect during consideration for development in various schemes of the then Government of Punjab. After the Haryana became a separate State in 1966, region of Panipat district, along with the rest of the State, has registered all round development in the field of agriculture sector and allied occupations owing to concerted effort of the Government in this regard. From 1966 to 1989 and upto1991 it remained part of Karnal district, during which it registered significant growth in agriculture sector and allied industry, namely animal husbandry, forestry, horticulture, fisheries, etc.

When Panipat became a district in 1991, the area under cultivation had been 1,08,000 hectares, whereas in 2010-11 it rose to 1,30,111 hectares. More than 70 percent of its population directly or indirectly depends upon agriculture sector. According to 2011 Census, 3.37 percent (as cultivators and agriculture labours) of the total working force of the district was engaged in

agriculture as against 4.74 percent of State as a whole. Among the working population of the district, cultivators account for 2.97 percent and agricultural labourers for 4.30 percent.

LAND UTILIZATION

Up to the last phase of 20th century, bajra (millet), maize, jowar (sorghum), barley and grams were major crops. Due to climatic changes and improved irrigation facilities there has been a substantial change in the cropping pattern of the district. With the expansion of irrigation facilities, there has been a shift in area in favour of more remunerative and less risky crops like paddy (rice), sugarcane, wheat, rape seed and mustard, sunflower, and vegetables. The major progress in the field of agriculture was achieved through 'Green Revolution' when it was a part of Karnal District. Now, Panipat is a leading district of the State in terms of production of paddy, wheat and sugarcane, and contributes significantly to central food-grains pool.

During 2010-11, the total land of the district measured 1,30,111 hectares. Out of this, the area of 3,000 hectares was under forest; 17,000 hectares was put to non-agricultural uses; 1,000 hectares was barren and unculturable land; 6,000 hectares culturable waste, and 7,000 hectares was current fallow. The remaining 96,000 hectares was the net area sown, of which an area of 95,000 hectares was sown more than once. The State Government is making concerted efforts to increase area under forest by introducing social forestry programmes and all other schemes related to development of forest.

Details of land use statistics from 1993-94 to 2010-11 are given as below:-

(Area in thousand hectares)

Classification of Area	1993-94	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Area according to village papers	127	130	130	130	130	130	130	130
Cultivated area	108	108	108	100	102	108	108	108
Forest	14	3	3	3	3	3	3	3
Uncultivated area	17	19	20	20	18	19	18	17
Net area sown	94	93	91	94	96	95	95	96
Area sown more than once	82	93	93	90	92	96	94	95
Total cropped area	**176**	**186**	**184**	**184**	**188**	**191**	**189**	**191**

Barren and Unculturable land.— This covers all barren and unculturable land like mountains, deserts, water logging etc. which cannot be brought under

cultivation except at an exorbitant cost. The total area of the land under this category in the district during 2010-11 was 1,000 hectares.

Current Fallow.— This represents cropped areas which are kept fallow in 2010-11. The net area sown in the district was 96,000 hectares. With the growing of trend for intensive cultivation, the practice of taking crops from the same plots successfully for a number of years is coming into vogue. Every effort was made to utilize, every strip of land for growing crops despite of the growing population for non- agricultural uses.

The Government is taking keen interest to ensure the cultivation of every available piece of land. To achieve this object it applied the East Punjab Utilization of Lands Act, 1949 and sought to take away the lands of owners which they were not cultivating. The Panchayats have also started using their lands for cultivation. The Government agencies are also encouraging the panchayats and the individuals to bring cultivable waste lands under cultivation by advancing loans for the purchase of tractors and implements and for sinking of wells, tube wells etc.

Water-logging.— It is a serious problem affecting the productivity of the land which supports only some aquatic plants like grass and weeds. The district forms a part of Indo-Gangetic plain and lies in the Yamuna sub basin of main Ganga basin. The worst conditions of water logging appears just after rains, when Yamuna overflows and water spread over the adjoining areas of eastern parts of the district. The width of the flood plain varies according to the amount of the shift experienced by the river. During the rainy season, all the human created hurdles like railways, roads, canals and constructed work restrict the natural clearance of water which results in sub-merging of a large area under water. The poor internal and surface drainage also causes water logging. The water area generally develops into alkaline land where normally, no crop can grow. As a sequence of water logging, the land is spoiled by *thur*, *kallar* and *sem.* The cultivated area which owing to sub-soil moisture become unfit for cultivation , or is so badly affected that it does not produce more than a four anna crop, is classed as a *sem.* The total area under water logging in the district was 749 hectares during 2010-11.

AGRICULTURE

In November, 1966 the district was under the control of Deputy Director of Agriculture, Karnal with Agricultural Inspectors and other field staff to promote Agricultural activities in the district. After 1st November, 1989,

Panipat became an independent Agricultural Unit headed by one Deputy Director Agriculture supported by SMS (Subject Matter Specialist), APO (Assistant Project Officer), STO (Senior Technical Officer), Horticulture ADO (Agriculture Development Officer), VEW (Village Extension Worker) and the other allied staff.

The Agriculture Department provides guidance to the farmers of the latest agricultural technology to achieve maximum agricultural production. These include intensive methods of cultivation for higher production per unit area through new cropping pattern suited to their conditions; preparation of crop plans, control of various pests and diseases affecting agricultural crops; use of fertilizers and good seeds; laying out of demonstration plots to show to the cultivators the supremacy of new varieties and agronomic practices recommended for the district. The Government takes keen interest in increasing agricultural production by popularizing improved agricultural practices and implements. The Agricultural Development Officer imparts training to the farmers in their respective areas. Loans are advanced to the cultivators for repairing the installing tube-wells and pumping-sets under the development of irrigation programme.

A few extension methods to transfer the technology to the farmers by the Agriculture Department and other similar agencies are agricultural shows and exhibitions; by organizing training camps (at district, block and village level) during *Kharif* (Summer) and *Rabi* (Winter) seasons by arranging field visits to the farms of the progressive farmers; laying of demonstration plots and mini kit trials by exhibiting extension articles and television talks; holding of Kisan *divas* and Kisan *melas*; by personal contacts, field visits and by issuing circular letters, bulletins and pamphlets etc.

SOILS

The district is situated on the western side of the Yamuna River and the whole of area forms a part of Indo-Gangetic alluvial plain. The district has two type of soils viz., tropical arid brown (sandy soil) and arid brown soils (clay loam). The arid brown soil is found in the major parts of the district, whereas tropical arid brown soil is found in North -Eastern parts of the district, especially in the parts of the Bapoli and Panipat blocks. The soil is deficient in nitrogen, organic matter, and low in phosphates and potash in almost all blocks. Therefore, it needs heavy manuring with organic matter like farm yard manure or green manure and treatment with nitrogenous and phosphatic

fertilizers, for obtaining good yield. There is a problem of salinity and alkalinity too.

The sub-soil water is mostly brackish, unfit for irrigation. However, the sub-soil water in the Sambalkha region i.e. around Delhi Ambala Railway Line is quite fit for irrigation. Depending upon the period of alluvial deposition, the area of the district is sub-divided into two categories, namely recent alluvial plain (*Khaddar*) and old alluvial plain (*Bangar*). Alluvial plain is composed of clay silt and sand. Yamuna alluvial plain is nearly levelled and is formed by thick sediments brought by the river. In general, the drainage of area is from north to south-east. The flood water is drained into the river Yamuna through various channels. Most of the area gets submerged during the rainy season.

Old alluvial plains are well drained except basins. The recent alluvial plain is undulated with 1 to 3 percent slope and its height from mean sea level ranges from 215 to 222 metres and the old alluvial plains is almost in level with high range with above mean sea level of 226 to 229 metres. The soil has good water holding capacity and is very fertile. Generally, paddy (rice), sugarcane, wheat, rape seed and mustard, sunflower, and vegetables are grown in the district.

CROPS

The crops grown in the district are divided into two main categories, viz. *kharif* and *rabi*, locally called *Sawani* and *Sadhi*. The former is the summer season harvest and the latter is of winter season. Any crop which does not strictly fall within these two harvest seasons i.e. summer and winter are known as *zaid* crops i.e. *zaid* kharif or *zaid* Rabi according to the harvest with which it is assessed. *Toria* (an oilseed) is cultivated as *zaid* kharif and some vegetables, melons, green fodder and sunflower as *zaid* rabi.

The major kharif crops are sugarcane and paddy, while the minor ones are subsidiary crops such as chillies, jowar, pulses (*Arhar, Moong* and *Mash*) vegetables, *til* and *sani*. The major rabi crops are wheat and oilseeds (*sarson* and *toria*) while minor ones are gram, *massar*, *berseem*, and oilseeds are main cash crops of the district. The wheat is the only rabi crop which occupies about 80 percent of the total cropped area. Bajra, *gwar* and *jowar* (*kharif*) are comparatively grown under *barani* condition and grow well in sandy soil. Similarly gram, oil seed and barely which are rabi crops are also suitable for these soils. Vegetables are generally cultivated in the vicinity of

the town where there is good demand for these vegetables. The table below gives the detail about the sowing and harvesting of kharif and rabi crops:-

Name of crop	Time of showing	Soil requirement	Time of harvesting
		Kharif Crops	
Paddy	15th May to 15th July	Clay or Clay loam	October to November
Maize	June to July	Loam (well drained)	September
Bajra	June to July	Sandy loam , Sandy	Middle of September
Gwara	July to mid of August	Sandy loam , Sandy	September to November
Sugarcane	Middle of February	Loam and Clay loam	End of November to end of April
Moong	April to July	Sandy loam /Loam/Clay loam	June to September
Arhar	June to July	Sandy loam /Loam	October to November
Jowar	April to July	Sandy loam	July to September
		***Rabi* crops**	
Wheat	October to December	Loam (well drained)	April
Gram	October	Well drained Sandy loam, Clay loam or all other poor soils	March
Barlay	October to December	Sandy / Sandy loam	March to April
Rabi (oilseed)	September to October	Sandy loam /Sandy/Loam	March

The detailed description of different crops grown in the district as to their area and production from 2005-06 to 2010-11 is given in Tables VI, VII and VIII of Appendix. However, the important kharif and rabi crops grown in the district are described in following paragraphs.

Paddy.— It is a semi aquatics plant, requiring abundant supply of water for its growth. Its nursery is sown in May and June and is transplanted from the end of June or beginning of July. It is a major kharif crop. The area under paddy during 2010-11 was 77,000 hectares. The district occupies 10th place in the state in the production of paddy. The popular varieties grown are high yielding varieties i.e. PR-106, Pusa 44, Punjab No.1, Basmati and B-370, PR-103,HKR-120, Pusa 221, Parmal 579, IR-64, HBN-I, and Pusa-33 etc. in the district.

Bajra.— It is mostly grown in *barani* area. The area under this crop fluctuates every year depending on the intensity of rainfall. It gives grain and fodder to farmers. The average yield of Bajra during 2010-11 was 1792 kilogram per hectares. The most common varieties, namely BJ-104, HHB-50, HC-4, WCC-75, MH-179 and MHB-60 etc., are sown in the district.

Wheat.— It is a principal *rabi* crop of the district. It is the most important among food crops and is the staple diet of the people. It is also a cash crop and is grown only in the irrigated areas. The area under this crop during 2010-11 was 87,000 hectares. The average yield during 2007-08 was 4375 kilogram per hectare which rose to 4584 Kg per hectare in 2010-11. The main high yielding varieties are sown in the district are namely WH-542, HD-2009, WH-533, PBW-343, C-306, WH-416, HD-2329, WH-147, WH-283, WH-157, HD-2448, Raj-3765, WH-291 and HD-2285 etc.

Sugarcane.— It is most important cash crop of the district and is grown almost in all tehsils, especially under much irrigated conditions. It is basically a kharif crop. The area under sugarcane during 2010-11 was 6000 hectare. The average yield during 2007-08 was 6823 kilogram per hectare which rose to 7599 kilogram per hectare in 2010-11. The main varieties of sugarcane grown in the district are COJ-788, COS-767, CO-1148, COJ-8436, COJ-788, COJ-79, COJ-64, COH-99, COH-56, CO-7717, CO-7314, COH-35, MH-1 etc.

Potato.— It is mainly a vegetable crop but due to increase in the area of this crop it has become commercial cash crop and is grown under irrigated and high fertility soil conditions. It is sown in both winter and autumn season but the autumn crop covers more area than the winter season. In the recent years the area under this crop has been a considerable increased. The area under this crop during 2010-11 was 1240 hectare. The main varieties grown in the district include Patna Gola, Kufri, D-Sanduri, Kufari Sectman, Chander Mukhi, Badshah and Bahar.

Chillies.— It is another cash crop. Chillies are grown mostly in Samalkha, Panipat and Bapouli blocks. During the year 2010-11, the area under this crop was 8215 hectare. Thus, there has been a considerable increase in area under this crop over the recent years.

Cotton.— This crop is grown in the district but not to any significant extent. The area under this crop was 1100 hectares with a total production of 680 tonne during the year 2010-11.

Oilseeds.—Rape seed (*toria*), mustard and sesamum (*til*) are the main oil seed grown in the district. In 2010-11, the area under cultivation was 1000 hectare.

The average yield of all these oil seed crops were 1868 kilogram per hectare during the same year.

Pulses.—Arhar, Mash (*Urd*) and Massar are three main pulses grown throughout the district. Arhar is generally grown as mixed crop with groundnut. It is generally grown in unirrigated conditions during kharif season. Mash is grown with *til*. Massar is grown as pulses during rabi under unirrigated conditions. These pulses are grown in all types of soils. Moong is also grown in few blocks of the district but its acreage is very low. Major varieties of different pulses grown in the district are: Prabhat (arhar), Mash, Mash-48, Mash-I, T-9, Moong No. 54 shining Moong No. 1 and Massar No. 9-12 No. TT3, T-35 etc. The area under pulses during 2010-11 was 600 hectare, and the total production was 900 tonne.

FODDER CROPS

About 10 per cent of the total cropped area of the district remains under fodder crops. Apart from these crops, the straw of *bajra, jowar*(Sorghum), maize and wheat along with minor cereals are used as animal fodder. The forage crops are generally grown in unirrigated condition during *kharif* season and irrigated condition in the *rabi* season. The important fodder crops are *chari*, green-maize, *jai, barseem* and of these *chari* is a leading kharif fodder and *barseem* is leading *rabi* fodder crop.

AGRICULTURAL PRODUCTION AND HIGH YIELDING VARIETIES

The scope for bringing more area under cultivation is very limited as maximum land (96 percent) has been brought under cultivation. The increase in the agricultural production has occurred due to enhancement in yield per unit area by updating package of practices for *kharif* and *rabi* crops in consultation with scientists of the Haryana Agriculture University (HAU), Hisar, use of high yielding varieties of seeds, balanced dose of fertilizers, optimum irrigation, water saving devices and plant protection measures. The high yielding varieties programme is in vogue in the district since its creation. Efforts are being made to bring more areas under high yielding varieties of four major crops i.e. Wheat, Paddy, Bajra and Sugarcane with the recommendation of HAU scientists. The year-wise details of area of the

district under high yielding varieties from 2003-04 to 2010-11 are given in the following table:-

(Area in Hectares)

Year	Area under High yielding Varieties of Wheat	Area under High yielding Varieties of Sugarcane	Area under High yielding Varieties of Paddy	Area under High yielding Varieties of Bajra	Total Area
2003-04	78,000	5,000	47,000	850	1,30,850
2004-05	80,000	5,500	40,000	850	1,23,850
2005-06	80,000	6,000	37,000	850	1,23,850
2006-07	79,000	7,000	42,000	900	1,27,900
2007-08	82,000	6,000	39,000	900	1,27,900
2008-09	84,000	3,000	36,000	900	1,23,900
2009-10	81,000	2,000	38,000	925	1,21,925
2010-11	80,000	6,000	38,000	925	1,24,925

AGRICULTURE IMPLEMENTS

The agricultural implements and machines play a vital role in increasing the agricultural production. The farmers are gradually mechanizing agriculture and adopting improved implements in accordance with their utility and scope.

Plough.—It is made of wood or iron. Its major parts are the beam (*hala*), wooden body (*hal*) and the coulter (*panhari*) and *Kuis*. The wooden one is generally made of *Kikar* wood but it is used by only a few farmers. The ploughing of the fields is done with the help of bullocks and it scratches the soil up to 4 to 5 inches. The main defect in ploughing by plough is that it leaves ridges of unploughed land between the V-Shaped furrows made by it. The plough is well suited for small and fragmented land holdings and non-contiguous plots, and it does not disturb the level of the land. But the use of iron plough has become more popular. There were 632 wooden and 1117 iron ploughs in 2010-11 in the district. The use of ploughs and bullocks for ploughing is decreasing with the increase of use of tractor for this purpose.

Tractor.— As already stated animal power (bullocks and *jhotas*) was chiefly utilized for cultivation but the use of tractor has increased rapidly. The district had only 4058 tractors in 1990-91 while the number has increased to 14030 in 2010-11. All types of tractors, small/medium/big are being operated in the district. Small land holders often use tractor on hire basis whereas big

landowners have their own tractors. Besides ploughing, tractors are also used for pumping out water from tube-wells during power failures and shortages.

Bullock carts.—This is the traditional load carrying device of the farmer. It is commonly used for carrying farm produce to the threshing grounds, grains to the home and surplus to the market. This is the main mode of transport of goods and of people to and fro fields. The wooden carts are being gradually replaced by paramatic wheel carts. There were 26023 carts in 2010-11 in the district.

Threshers.—Use of thresher for threshing grain crops has become very popular with the farmers of the district. This device helps the farmers in finishing the threshing work timely, with efficiency and thereby providing enough time for the preparation of land for next crop(s). Old models of threshers are prone to accidents have been replaced by the improved models to minimize the risk of accidents. It is estimated that there were about 7420 threshers in the district in 2010-11. However, the use of Harvester Combine Machine is gaining popularity amongst big farmers.

Potato Ridger.— The use of potato ridger has become very popular with the potato growers of the districts as it helps the farmers to get their produce with minimum damages.

Cane Crusher.— It is another important agricultural implement used for crushing sugarcane. Wooden crushers in vogue before independence have been replaced by steel crushers although their number has remained more or less the same. Most of the sugarcane produced in the district is supplied to Sugar Mill, Panipat and the little is crushed locally for making *gur* or *khandsari* for local use. There were 65 sugarcane crushers in the district in 2010-11.

There are certain other agricultural implements which are very popular and useful to the farmers, especially small and medium farmers, such as *Kasola* (smaller mattock for weeding and hoeing), *Jeli* (two pronged fork), *Chausangi* (four pronged fork), *Panjali* (multi pronged fork) *Dranti* (Sickle), *Kassi* (Large Mattock spade), *Gandasi/Gandasa* (fodder cutter), *Khurpa* (grass spade), *Kuhari* (hatchet). These are traditional implements which are still in use for agriculture operations in the district.

SEEDS

The Agriculture Department plays an important role in popularizing the use of improved seeds. It also concentrates on multiplying and distributing

improved seeds to the farmers. Rice, Wheat, Sugarcane and forage crops are the major sowing in the district. The varieties of these crops are provided by National Seeds Corporation, Haryana Seeds Development Corporation, Agricultural Universities and the Government farms through the Agriculture Department. The major varieties of sugarcane sown in the district are CO89003, COS8436, COH119, COJ64, and COH99. The major improved varieties of wheat and rice grown in the district are given in tables IX and X, respectively, of Appendix.

The varieties of Jowar (Sorghum) are mainly non-descript type. Its recommended varieties are not available while only few progressive farmers use the Sorghum-SSG-hybrid developed by private companies. On the other hand, the varieties of *barseem* grown in the district are *mascavi* and *varietal*, diversification is critically required. The Agriculture Department in the district during 2005-06 distributed the improved quality of seeds 8,433 quintals which rose up to 12,786 quintals in 2010-11.

MANURES AND FERTILIZERS

The use of manures and chemical fertilizers has increased considerable during the last phase of 20th century. The farmers use compost, farm-yard manure and chemical fertilizers to increase agricultural production. Urban wastes were neglected earlier by the farmers who did not use it due to social prejudices but now urban wastes in the form of compost are being used considerably in the field of agriculture for high yield of crops. Green manuring with leguminous crops add fertility to soil is also being used on large scale. Among all kinds of manuring practices, green manuring has been found to be cheapest. However, the farmers have accustomed to the use of chemical fertilizers etc.

Urban Compost.— Urban wastes are good potential source for increasing plant food ingredients. Efforts have been made in the recent past to conserve these wastes for manorial purpose. The Municipalities of Panipat, Samalkha and Notified Area Committee, Madlauda, Israna are producing urban compost which is sold to farmers. The Government also provides advances and subsidies to the local bodies for preparing compost manure.

Rural Compost.— The preparation of compost manure in the rural areas is also being promoted. The agriculture extension workers in the field advise

farmers in villages for the preparation of compost and train them in the technique of scientific composting.

Green Manuring.— Green manuring is very important for increasing soil fertility as it directly adds nitrogen to the soil. It also improves soil texture by addition of human or organic matter. The addition of organic matter improves both heavy and sandy soils as it has a binding effect on loose particles of sand soil, and makes tough and heavy soil friable. The water holding capacity of the soil also increases. Further, it creates better conditions for increasing useful bacteria in the soil. The practices of green manuring with sunhemp and *daincha* are being steadily popularized. The area under green manuring in the districts during 2005-06 was 60984 hectares which increased to 72008 hectares in 2010-11.

The following figures regarding the distribution of chemical fertilizers show that the use of chemical fertilizers is becoming more and more popular among cultivators of the district:-

(In metric tonnes)

Year	Nitrogen	Phosphatic	Potash	Total
2004-05	50253	11475	320	62048
2005-06	47099	11834	1257	60190
2006-07	38154	8923	283	47360
2007-08	36399	7967	549	44914
2008-09	33821	7499	396	41716
2009-10	33823	8936	772	43731
2010-11	36858	10104	1020	47982

CROP ROTATION

Two crops in a year is a common practice in the area where assured and sufficient water supply is available. Due to excessive use of land, the soil becomes deficient in some nutrients such as nitrogen, potash, iron etc. To overcome this difficulty, the farmers are generally advised to grow those crops which are considered rich in above nutrients such as Pulses, Sunhemp, Gwar etc.

Mustard (*Sarson*) sown for fodder is removed early and wheat is allowed to grow. It is common practice to grow pulses which are short growing crops along with kharif cereals i.e. *Mah* is grown with Maize and

Moong with *Jowar* or *Bajra*.

The rotation varies according to types of soil and condition of irrigation i.e. irrigated and barani. However the general rotation of crops followed by the farmers is given below:-

Wheat	Toria
Rice	Barseen-Rice-Wheat
Rice	Wheat
Maize	Barseen-Maize-Wheat
Wheat	Chari-Maize-Gram
Fallow-Toria	Sugarcane
Maize	Wheat
Bajra	Chari-fallow-Wheat
Bajra	Chari-Gram/Wheat
Maize	Potato, Onion

PESTS, DISEASES AND PLANT PROTECTION

Due to rise in intensity of cropping, incidences of diseases too have increased. Protection of crops from the pests and diseases assumes special significance in the wake of increased consumption of fertilizers and improved verities of seeds. Plant protection measures contribute significantly towards enhancing agriculture production. A list of various major crops, their pests and diseases is as follows:-

Crop	Pests / Diseases
Sugarcane	Top borer, Shoot borer, Pyrilla, Gurdaspur borer
Cotton	Jassid White
Rice	Bug
Sarson	Aphid
Gram	Cut warm
Wheat	Loose smut, rust
Barley	Covered smut
Maize	Top borer

Fruits Pests and Diseases		Stored grains pests
Citrus	Pyrilla, Cander	Khapra
Lemon	Caterpillar	Sursi
Mango	Hopper, Mealy bug	Dhora

These pests and diseases attack the standing crops and stored grains. The Agriculture Department advises farmers through intensive propaganda regarding control of these pests and diseases. Besides these, weeds like mandhusi, poohli, sanwak, piazui, bothua, kurund, khli, mena etc., are prevalent in the district.

The plant protection work has become very important on the modern agricultural technology as pests and diseases attack the crops from the time of sowing to the time of harvesting. Farmers have become conscious to protect their crops against the pests and diseases. High yielding varieties of crops are more prone. The plant protection work has caught rapid momentum after the creation of Haryana. In Panipat, the work of Plant Protection is looked after by the Assistant Plant Protection Officer, Panipat. He is assisted by Agriculture Development Officer(Plant Protection). Sufficient stocks of pesticides and fungicides are available with ADO (PP). Farmers can take on loan basis plant protection equipment from ADO (PP) against payment of nominal charges. In 1990-91, there was heavy attack of pyrilla and the government protected the sugarcane crop by regular and large scale aerial spraying operations. The work of pyrilla control in the district is done in collaboration with the Panipat sugar mill authorities.

The quantity of pesticides used in the district, block-wise, during the period 2006-07 to 2011-12 is given below:-

(in metric tonne)

Block	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	Total
Panipat	31	33	34	35	36	37	206
Samalakha	32	34	35	36	37	38	212
Madlauda	38	39	40	41	42	42	242
Israna	30	31	32	32	33	33	191
Bapoli	31	33	33	33	33	33	196
Total	**162**	**170**	**174**	**177**	**181**	**183**	**1047**

Before the introduction of high yielding varieties of various crops plant protection work was restricted to a limited area. In the beginning in 1970s, to popularize the use of pesticides and fungicides, they were subsidized but during the 4th Five-Year Plan the subsidy was withdrawn by the government.

VEGETABLES

Cultivation of vegetables has increased considerably with the increase in irrigation and transport facilities. The increase in cultivation area of vegetables is notable particularly in villages adjoining the district headquarters and towns. The eating habits of the people in the villages are also changing and vegetables are becoming an important part of their diet. Consequently, a majority of farmers in villages having enough water for irrigation have started growing vegetable not only to meet their own requirements, but also to make livelihood out of it. The increase in area of cultivation can be attributed to a demand of large quantity of vegetables by National Capital Region (NCR), Delhi. Depending on their season, the following vegetables are grown in the district:-

Summer vegetables: Cucumbers (*Tar* or *Kakri/ Kheera*), Bottle gourd (*Ghia kadoo*), Sponge gourd (*Ghia*), Pumpkin (*Petha*), Ridge gourd (*Tori*), Apple Gourd (*Tinda)*, Brinjal round and long (*Baingan*), Tomato, Lady finger (*Bhindi*), Musk melon good type (*Kharbuza*), Water melon (*Tarbuz*), Chillies (*Mirch*), Sweet-potato (*Shakarkand*) , etc.

Winter vegetables: Radish (*Mooli*), Turnip (*Shalgam*), Carrot (*Gajar*), Spinach (*Palak*), Methi (*fenugreek*), Potato (*Aloo*), Cauliflower (*Phulgobhi*), Cabbage (*Bandgobhi*), Peas (*Matar*), Onion (*pyaz*), Coriander (*Dhania*), etc.

Improved hybrid varieties with a better quality yield and improved nutritive value are preferred by farmers over the old type. The common vegetable pests found in the district are Red Pumpkin Beetle, Brinjal Hadda, Potato and Bhindi Jassid, Singhara Beetle, etc. Mushroom farming is also a common feature in the district. In 2010-11, 1360 tonnes of mushrooms worth ₹340 lakh has been produced by about 225 growers. The total area under cultivation of vegetables was 16375 hectares in 2010-11.

FRUIT CROPS

Mango, Gauva, Citrus, Chiku, Litchi, Pear, *Ber*, Grapes, Aonla (*Amla*) etc. are grown in orchards in district. The total area under fruit crops in 2001-02 was 428 Hectares which rose to 686 Hectares in 2010-11. The fertile soil, improved irrigation facilities and technical support from Horticulture

Department, Haryana are reasons attributable to the significant increase in the area of fruits crops in this district.

IRRIGATION

The district has a sub-tropical continental climate. From relief point of view it is a plain area. The river Yamuna on the eastern side forms a flood plain along its bed. Loam (*Banger and Nardak*), and silty loam (*Khaddar*) soils are found in the district. The underground water is comparatively high. The sub-soil water along with Yamuna river belt and along with the Delhi-Ambala railway line is fit for irrigation except for some western part of district. The general slope of water in the district is from North to South. Irrigation in the district is done mostly by canals and tube wells. The net irrigated area by different means during the year 2005-06 to 2010-11 is as follows:-

Year	Canals	Tube-wells	
	(Area in Hectares)	Diesel sets	Electric sets
2005-06	5816	6873	25371
2006-07	5763	4003	25662
2007-08	5180	4046	26272
2008-09	5423	3711	26849
2009-10	4821	3098	27429
2010-11	4256	3033	28896

During 1991-92 the net area under irrigation by all means was 68.239 thousand hectares, it increased to 68.376 thousand hectares in 2010-11. In 1991-92, the area irrigated by canals was 33.304 thousand hectares, which rose to 34.256 thousand hectares in 2010-11. The crop-wise gross area irrigated in the district during the year 2005-06 to 2010-11 is as follows:-

(Area in thousand hectares)

Name of Crop	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**	**2010-11**
Rice	16123	15893	15680	16375	16406	16131
Wheat	16555	16391	16202	16234	16413	15965
Sugarcane	591	958	1054	341	210	486
Jowar	1442	1539	1461	1229	1096	933
Barley	800	772	660	777	589	587
Other Pulses	60	18	55	49	53	102
Cotton	32	48	32	31	32	24

Western Yamuna (Jamuna) Canal.— This canal was originally dug during the reign of Firozshah Tuglaq to conduct water to Hisar and Hansi, it incidentally irrigated the intervening tracts also. It was re-excavated in Akbar's reign to bring supplies from river Yamuna and its tributary: the Somb into the Chautang and on to Hansi and Hisar. This has been a perennial canal. It was further improved upon during the reign of Shah Jahan with the object of diverting water to Delhi. The river supply was tamed about 22.5 kilometres below the present headworks of the canal and the water was led along the drainage line through the Panipat and Sonepat lines to Delhi.

The Western Yamuna Canal originates from the Yamuna at Tajewala headworks from Yamunanagar district where a very strong masonry 'Dam' is built across the river. From the main canal the Sirsa branch bifurcates at Indri (Karnal). At Munak (Karnal), about 49.0 kilometres down, the canal further divides into the Hansi Branch, Gohana distributory and Delhi Branch.

The distributaries arising out of the Western Yamuna Canal are the main source of irrigation in the district. A network of distributaries, minors and sub-minors has been developed and managed by the Irrigation Department for seamless irrigation of the agricultural land in the district. The detail of the water channels of the district is given in Table XI of the Appendix.

Wells.—Well irrigation is possible in areas where subsoil water is sweet and available in plenty. The quantity of underground water depends on many factors such as rainfall, depth of water table in the area, type of underground strata and its nearness to a natural stream. This practice was the main source irrigation in *Khadar* area in the past. The well irrigation has almost vanished from last two decades due to development of canal network in the district and easy availability of machinery of tube-wells and pumping sets.

Tube-wells and Pumping sets.— Tube-Wells and pumping sets were introduced after Independence. The pumping sets initially replaced the old traditional method of raising water manually from the wells. With the electrification of villages, electricity operated tube-wells being economical gained popularity. Tube-wells and pumping sets serve to reduce the water lodging and check the rise in the water-table in the district and are the second largest source of irrigation following only the canal system. During 2010-11, as many as 31,929 tube-wells and pumping sets were in use for irrigation of land in the district.

ANIMAL HUSBANDRY AND DAIRYING

Livestock development plays an important role by providing gainful employment apart from providing food of high nutritious value for the health and well-being of the people. Animal Husbandry activities relate to cattle breeding, artificial insemination work, control of the outbreak of contagious diseases amongst livestock, improvement of livestock and provision of veterinary aid.

The major part of population is engaged in animal husbandry which is next to agriculture. As the human population is sharply increasing day by day so the demand of milk, eggs and meat is also increasing. In order to meet this increasing requirement, the Animal Husbandry and Dairying Department of the State is taking up various livestock development programmes.

Revolutionary progress has been made in the district in recent years in improving the breed of cattle through selective breeding, culling of undesirable animals and upgrading the indigenous breeds by crossing them with improved bulls. Artificial insemination for improving the breed of cows and buffalos has been started in all the veterinary hospitals and dispensaries located in the district. Loans are also given to the breeders for purchase of cows and buffaloes of improved breed.

The district possesses a fairly large number of livestock including cattle, buffaloes, horses and ponies, goats and pigs. The livestock population in the district as per 2003 and 2007 Census was as under:-

(Numbers in lakhs)

Particular	2003	Percentage	2007	Percentage
Cows	0.44	8.80	0.40	1.92
Buffaloes	2.86	57.20	2.58	12.36
Sheep	0.12	2.40	0.09	0.43
Goats	0.05	1.00	0.07	0.34
Pigs	0.04	0.80	0.08	0.38
Horses	0.02	0.40	0.01	0.05
Donkies & Mules	0.01	0.20	-	-
Poultry	1.22	24.40	17.60	84.29
Others	0.24	4.80	0.05	0.24

The comparison of the livestock population of 2007 with respect to 2003 reveals that there is an increase in population of goats, pigs and poultry and a decrease in population of cows, buffaloes, sheep, horses and donkey/mules.

The animal husbandry activities in the district are looked after by the Deputy Director, Animal Husbandry and Dairying, who is assisted by 35 Veterinary Surgeons, 113 Veterinary Livestock Development Assistants (VLDA), who render their services at 34 Veterinary Hospitals and 73 veterinary dispensaries in the district. Facility of one Mobile Veterinary Clinic and Diagnostic Laboratory is also available in Panipat. The main Officers at district level are Sub-Divisional Officer (Animal Husbandry), Panipat and Samalkha.

Cattle and Buffaloes.—In the past animals, especially cattle play an important role in the economy of the district. The essential equipment of the peasant included a pair of oxen or male buffaloes (*jota*) for ploughing of fields and for pulling carts. Now, in agriculture sector, bullocks have been replaced by tractors, motor transport and electric power. So, the livestock population is showing a decreasing trend in the State.

The Royal Commission of Agriculture in India remarked about cows in India that "in most parts of the world, they (cows) are valued for food and for milk; in India their primary purpose is draught for the plough or the cart". To at least half of the population of India, the slaughter of the cow is prohibited owing to the widely known religious veneration accorded to the cow by the Hindus, and this outstanding fact governs the whole problem of improvement of cattle in this country.

The district has been predominantly populated with non-descript cattle of mixed breeds. The scheme envisaged artificial insemination and controlled breeding through castration of scrub bulls. Later on, it was felt that stock could be improved more beneficially by cross breeding the cows. To promote crossbred cows, exotic bulls known for their high milk yield were more useful. For exotic breeding, in cows and Murrah buffaloes, the semen is supplied from the Semen Storage Bank, Karnal. The figures of artificial insemination carried out and calves born during 2005-06 to 2010-11 are given in the following table:-

(Figures in Thousands)

Year	Artificial insemination		Calves born	
	Cow	Buffalo	Cow	Buffalo
2005-06	15.0	49.0	4.0	12.0
2006-07	17.0	61.0	5.0	15.0
2007-08	20.0	64.0	8.0	20.0
2008-09	24.1	67.7	7.6	19.5
2009-10	26.9	70.0	8.9	22.0
2010-11	28.6	77.8	9.4	22.5

Sheep breeding.— According to 2007 Livestock Census, the sheep population in the district was 9,000 only. Sheep provide necessities of vital importance, e.g. meat for food, wool for clothing, skin for industrial enterprise and manure for agriculture. As the number of sheep is small in the district so the veterinary institutions functioning in the district have been entrusted with the work of sheep development.

Piggery development.—The pig population according to 2007 Livestock Census is 8,000 in the district. To improve and develop piggery, the pigs produced at the Government Livestock Farm at Hisar and Pig Breeding Farm at Ambala are supplied to the breeders at subsidized rates. The veterinary institutions functioning in the district also undertake such work.

Poultry Farming.—According to 2007 Livestock Census, there were 15.81 lakhs poultry birds in Panipat. The district has a great potential for poultry development on account of its proximity to NCR, Delhi and Grand Trunk Road passing through it. The poultry and eggs produced in the district find a ready market in Delhi. The breeders of the district are supplied with White Leghorn (W.L.H.) Chicks at subsidized rates either from Hatchery-cum-Poultry Farm, Hisar or Government Poultry Farm, Ambala. Mass-scale vaccination and debeaking (removal of sharp beak tip) are carried out by the veterinary institutions working in the district from time to time.

Animal Diseases.— The major diseases prevalent in the district are Haemorrhagic Septicaemia, Foot and Mouth, Fowl Pox, Ranikhet, Sheep pox, Enteronema, PPR (Peste des Petits Ruminants) and Black Quarter. These diseases are controlled with prophylactic vaccinations and curative measures. Regular campaigns for inoculation and vaccinations against these diseases are conducted.

Haryana Agriculture University, Hisar provides surgical treatment facility, Animal Disease Investigation Staff and Diagnostic Service to the field veterinarian and livestock owners. In case the field staff is not able to diagnose the disease, the matter is referred to the Disease Investigation Staff of the University. After conducting the laboratory examination, the suitable preventive and curative treatment is recommended for the control of diseases in such cases.

During 2010-11, 1.38 lakh animals were treated in the various veterinary institutions. The details of vaccinations and inoculations performed in the district are given below:-

(in lakhs)

Disease	Number of animals vaccinated and inoculated.		
	2008-09	2009-10	2010-11
Haemorrhagic Septicaemia	4.43	4.00	3.33
Foot & Mouth	2.62	1.87	1.88
Fowl pox	0.34	0.24	0.24
Ranikhet	0.34	0.24	0.18
Sheep pox	0.12	0.10	0.08
Enterotomia	0.07	0.09	0.05
PPR (Peste des Petits Ruminants)	0.13	0.12	0.07
Swine fever	0.11	0.02	0.01

Slaughter house.— There is one slaughter house in the district, located in Panipat. The animals (goats, sheep and pigs) are inspected by the Veterinary Surgeon before and after their slaughter, to ensure that meat being made available for human consumption is free from any diseases. During the year 2010-11, 7800 animals were slaughtered.

Gaushala Development.— According to the old concept, gaushalas (cowshed) were inspired by religious sentiments to house the unproductive, weak and aged cows and these were run on charity. To give new meaning to the old concept, an idea was mooted to convert these institutions into 'Cattle Breeding–cum-Milk Producing Centres' with some financial assistance and technical guidance. Out of 18 registered Gaushalas in the district, 5 gaushalas are situated in Panipat city, 2 in Samalkha, 2 in Patti- Kalyana, 2 in Kurana, and 1 each in Madlauda, Dikadla, Mohmadpur, Diwana, Shahpur, Bapauli and Naultha.

DAIRY FARMING

Milk is derived from buffaloes and cows, but the buffaloes constitute main source of milk supply in the district. With the increasing concentration of population in urbanities of the district and with the rise of the prices of milk, dairying has become a profitable business. A large number of people in the villages and towns maintain small dairies for supplying milk to the towns. Some of the people keep cows and buffaloes to meet their own requirements of milk and milk products.

As per 2003 and 2007 Livestock Census, the number of buffaloes and cows in milk is as under:-

(in lakh)

Classification	2003		2007	
	Cows	Buffaloes	Cows	Buffaloes
In milk	0.12	0.87	0.13	0.82
Dry	0.06	0.35	0.05	0.28
Not calved even once	0.01	0.12	0.01	0.09

The farmer can be interested in maintaining quality milch animals for commercial milk production, if he finds ready and remunerative market for milk at hand. In 1959, Delhi Milk Scheme was initiated by the Government of India to cater the milk requirements of Delhi in an organized manner. It was also to provide a fair remunerative market for milk producers in area neighbouring Delhi.

The venture of Delhi Milk Scheme could not succeed in this district for various reasons. First, Delhi Milk Scheme did not take any measures to increase milk production in the area. Secondly, the attractive prices were not offered to the milk producers (farmers). The price at which milk was sold for local consumption was generally higher than the price offered in the Delhi Milk Scheme. With industrialization and the resulting urbanization in some of the areas of the district, local demand of milk increased considerably. The milk collection and chilling centre established by Delhi Milk Scheme could not succeed.

As in other parts of the State, the milk trade remained disorganized in the district and the prices of milk and milk products ruled high during summer season. The dairy on modern lines was absent. To develop the dairy industry on commercial lines, the Dairy Department was set up in Haryana in 1974. Dairy department licensed one chilling centre at Ugra Kheri and one Milk Plant (Nestle Milk Plant) at Patti Kalyana.

To develop the dairy and animal husbandry in the State, two training centres were established at Karnal and Gurgaon in 1976-77 and 1981-82, respectively. For training purposes, the district was tagged with Karnal Training Centre. Those young men, who have a desire to install a dairy, are given training for 21 days under the self-employment scheme. Later on, Dairy Department established training centres at sub division level in each district in the State. In May 2003, the Dairy Department was merged with Animal

Husbandry Department by the Government. A Mini Dairy Scheme was also initiated by the Government during 1979-80 to provide self-employment opportunities to the young persons. Under this scheme rural young men/ women are assisted in securing loan through various Nationalized Banks. The department provides insurance margin money and attractive subsidy to the loanee. The achievement made pertaining to the Mini-Dairy Schemes (20/10 milch animals scheme, 5 milch animals scheme and 3 milch animals scheme) is as shown below:-

Name of the Scheme	Persons who were given loan			Buffaloes purchased		
	2008-09	2009-10	2010-11	2008-09	2009-10	2010-11
20/10 milch animals scheme	4	0	6	6	70	73
5 milch animals scheme	2	2	2	2	12	6
3 milch animals scheme (S.C.)	119	80	75	275	157	155
3 milch animals scheme (G.C.)	2	0	0	5	0	0

Scheduled Caste Special Programme Scheme.— In year 2008-09, the Department has launched a SCSP Scheme in the district wherein scheme 2/3 milch animals dairy scheme sheep units, goat units, pig units and calf rearing units are to be established by the scheduled caste families and different rate of subsidy will be given by the department to the loanee.

FISHERIES

The office of Fisheries Development Officer, Panipat was created in 1991. Now, this post is named as District Officer–cum-Chief Executive Officer, Fish Farmers Development Agency, Panipat. His functions are under the administrative control of the Director Fisheries, Haryana.

The main aim of the department in the district is adoption and development of fish culture and its objectives include extension of fishery activities like conservation of fisheries ponds and tanks, cultivating of the notified water, canals and stocked ponds; survey of new ponds suitable for fish culture, stocking thereof; production of fish seed of stockable varieties by induced breeding; providing assistance for adoption of fish culture to the interested person especially weaker sections.

The farmers are adapting intensive fish culture in ponds and tanks on modern scientific lines through composite fish culture of fast growing species. Most of the ponds are seasonal, by the proper renovation; these can prove useful for fish culture. The rights and management of village ponds are with the panchayats. Financial assistance and supply of quality fish seed are provided to fish farmers by the fisheries department.

District Panipat has huge water resources in the form of river, canals, drains and ponds. These resources offer a significant potential for increasing fish production and for generating income. The notified waters in the district are River Yamuna, Diversion drain No 8, Baberpur Nala and West Yamuna Canal. The time period of close season is observed from 1st July to 31st August. The notified waters are auctioned by the Director of Fisheries, Haryana through open auction. The amount fetched through auction during 2012-13 was ₹8.86 lakhs. Department survey was conducted and it was found that about 270 ponds, covering the water area of about 827.6 hectares, were suitable for fish culture. Panchayats lease out ponds to the fish farmers on 5 years term basis. In 2007-08, total water area brought under fish culture was 562 hectares and 3064 tonnes of fish were produced which rose to 827.6 hectares in 2012-13 with the fish production of 5390.5 tonnes. The block-wise area brought under the fish culture during 2012-13 is as below:-

Block	**Area** (in hectares)	**Fish production** (in tonnes)
Panipat	123.0	760.0
Israna	171.5	1130.0
Madlauda	221.5	1508.5
Bapouli	151.3	982.5
Samalkha	160.3	1009.5
Total	**827.6**	**5390.5**

Catla, Rohu, Mirgel, Common Carp, Silver Carp, Grass Carp, Kalbasu, Bighead, and varieties of catfish are sold as food fish in the district. The varieties of catfish found in the district are Malhi-Wallagoattu, Seenghala-mystus-seenghala, Pari-notoperus-notoperus, Desi-Magur, Magur, Singi, Sol Silond Bam and Chitala. Approximately, 20 to 25 quintals of fish arrive daily in the markets of the district for consumption.

FORESTS

Area under forests include actual land, classed or administered as forests under legal enactment detailing with forest state owned or private, wooded or maintained potential forest land. The area of the crops goes in the forest and grazing land for areas open for grazing within the forest is included in the forest area. However, the forests mainly consist of waste strips on the sides of roads, canals and railways etc.

There is no reserved forest under the control of this division. Forests of this district mainly comprise waste strips on both sides of the railway lines, canals, drains and bunds.

Classification of Forests	**Area** (In Hectares)
(A) State	
1. Reserved Forest	--
2. Protected Forest	
a. Compact Block	--
b. Strips	
i. Railway tract	295.0
ii. Roads	967.50
iii. Canals	2734.67
iv. Bunds	89.45
(B) Unclassified	
(C) Private Forest	
Closed under section 38 of Indian Forest Act, 1927	72.00
Total	**4158.62**

The total area under the strip forest in the district during 2010-11 is 4158.62 hectares and is spread all over the district. The total forest area is 2.4 percent of the total geographical area of the district. Since the area notified as forest area includes the metalled road, existing canal course and railway tract which almost consumes the two-third of the notified area, therefore, actual tree cover is less than one percent of the total geographical area.

The plantation of varying ages of trees like *shisham, kikar,* eucalyptus, poplar, neem etc. are found in the district. The existing and planted forests of the area are being given suitable culture and sericulture treatment to bring them under scientific management. According to the revised 'Survey of Forest types of India' by Champion and Seth, the vegetation of the tract falls under the sub group '5-8 Northern Tropical Dry Deciduous Forests'.

NATURAL CALAMITIES

Floods.— The seasonal overflow of Yamuna coupled with heavy rainfall is a major cause of flood in the district. The Yamuna passing along the eastern boundary of the district is only natural drainage line which provides a suitable natural outfall for the drainage of the district. The district suffered much from floods in the past. Some of the worst floods which hit the district during the

20th Century occurred in the years 1924, 1925, 1960, 1961, 1963, 1964, 1967 and 1976. In 1978, the district was directly hit by flood due to the heavy rainfall in Yamuna's catchment area and the discharge in Yamuna was more than 19825 m^3/sec (7,00,000 cusec) in the month of September. As a result of high water level, Panipat district was the worst affected. After the devastation caused by floods, the state government prepared a master plan costing ₹150crore (whole State) and executed most of them for long term mitigation measures of flood. The following schemes were part of the master plan in relation to the district:-

I. Construction of link drains.
II. Constructions of ring bunds around villages,
III. Construction of river embankments and river protection work along river Yamuna.
IV. Remodelling of all the drains including Main drain No. 2, running from the left bank of Sirsa Branch irrigation canal to Panipat, draining the Chautang and the northern part of the basin, discharging into the Yamuna.

Whereas the floods of years 1978 were caused by river on account of heavy rainfall in their catchment area, the floods in 1983 were caused by extremely intensive rainfall in the district. The drain no. 2 and other drains were not able to carry the heavy discharge from some part of the district causing flood leading to extensive damage to property life and cropped land. In 1988, in the month of August, the district again became a victim to flood during the monsoon season. Some villages of the district were affected due to the heavy rainfall and water-logging. The crops and infrastructure were affected and flood protection work received a setback. In 1995, high stages in the Ghaggar river conceded once more with heavy rainfall between 200 mm to 250 mm from 2nd to 4th September over much of the State causing inundations of large areas. The situation was exacerbated by entry of floodwater from Punjab through the SYL Canal affecting hundreds of villages of Panipat and other neighbouring districts. In Panipat, almost all the urban and rural areas were submerged under 60 centimetres to 3 metres floodwater that remained stagnant for many days. All drains and canals overflowed and were not able to drain out the surface runoff. Road networks, Public Health installations including water works, electric installations etc. were badly damaged.

In 2010, heavy rainfall in the catchment area of Yamuna and its tributaries caused an abrupt increase in the discharge of river Yamuna from 30,000 cusecs (on 7th September) to 3,30,000 cusecs (on 8th September) at Hathni Kund Barrage which further increased to peak discharge of 6,07,000 cusecs on the same evening. Due to heavy rains in Yamunanagar catchment area, an additional 1,00,000 cusecs of water was received in Somb and Pathrala rivers which further added to the flow in river Yamuna making the discharge to a high of 7,07,000 cusecs. In the wee hours of 10th September 2010, a breach of about 80 feet of embankment occurred between villages Thamsabad and Pathergarh resulting in the entry of water in the adjoining fields. However, no water entered in any village due to protection by bund near village Snoli which was strengthened in time by deploying men and machinery. The district Administration had timely taken all precautionary measures like evacuation of people in the flood prone areas, patrolling along the bank of Yamuna and sending alert messages to the flood prone areas etc. Major damage to the life, property and crop was avoided due to the proper, development of infrastructure, and preparedness of administration.

Prevention of floods.—Generally, after the flood season, all flood affected areas are inspected and schemes are prepared by the District Flood Control Committee constituted, under the chairmanship of Deputy Commissioner, for this purpose, on the basis of experience of floods for short term and long term measures. Schemes and measures so proposed by "Flood Control Committee", are further technically scrutinized by the Technical Appraisal Committees consisting of Superintending Engineers of Irrigation Department, Public Health Department, Building and Roads and Police Department, the highest of which consist of Chief Engineers and other senior officers of Haryana Irrigation Department. After detailed technical scrutiny, feasible schemes are recommended for consideration and approval of 'Flood Control Board, Haryana'. The Board in its meetings, of Administrative Secretaries chaired by Chief Minister, considers and approves projects of flood protection works of about thirty crore rupees every year.

After approval, the priority schemes are taken up for execution in proportion of availability of funds. The priorities of the schemes are fixed by the Deputy Commissioner for short term and long term measures. Every year on setting of the monsoon, all big and small drainage are de-weeded and cleared of all obstructions. The comprehensive inspection of all the drains and bunds are carried out both by the Deputy Commissioner and the officers of Irrigation Department.

Famine.— The first famine (*akaal*) of which there is any credible record is that of 1783, which is talked of to this day as *Sunchalisa* (*samvat* 1840). It

affected the whole country from Satluj to Illahabad and was acute in the neighbourhood of Delhi.[3] Besides the *Sunchalisa*, the district has been visited by famine many a times. The details of famines and droughts in last three centuries in the district are as given in the following table.

Name of Famine (*Akaal*)	A.D.	Samvat
Dasa	1753-54	1810
Chalisa	1782-83	1840
Satha	1802-03	1860
Unhattara	1812-13	1869
Chauhattara	1817-18	1874
Nawbia	1833-34	1890
Chauranwa	1837-38	1894
Satraha	1860-61	1917
Pachisa	1868-69	1925
Chautisa	1877-78	1934
Seinteesa	1880-81	1937
Bawanwa	1895-96	1952
Chhapana	1899-1900	1956

The history of droughts and famines in the region of Panipat is very painful. During the 18th and 19th centuries, the droughts and famines had been the regular phenomena in the region. In 1833 A.D. (Samvat 1890) the whole region was overwhelmed by the most terrible famine which village tradition can recall forming the epoch from which old men fix the dates of events. In many villages, no land was ploughed up for the autumn crop; in but few was any seed sown; in none was a crop reaped. The cattle died; grain rose to 8 seers per rupee, and the people followed their cattle; while crowds of emigrants form the highlands to the west poured into the district to help the residents to starve. As early as the end of April there was not a blade of grass to be seen for miles, and the surrounding plains were covered with the carcasses of the cattle which had died from starvation.[4]

In 20th century, adoption of systematic relief measures reduced the number and gravity of famines. With the spread of irrigation facilities, increase in the means of communications and relief measures famines have ceased to occur in the district.

* * * *

Notes and References

[1] Dr.B.L.Sharma, *Economic ideas in Ancient India before Kautilya*, New Delhi, 1987, p.117.
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[4] Karnal District Gazetteer, 1892, p.26.