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Assessment Of Quality Of Soil For The Improvement Of Agriculture Activities In Najafgarh Area,Gurgaon,Haryana

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Abstract:

The HRSEZ is proposing to occupy an area of 25000 acres of land partly in Gurgaon district and mostly in Jhajjar district. The Groundwater moves from all the directions towards the area. Hence water logging is very common feature in this region. According to agricultural qualities, the study area can be divided into several small areas namely Brick kiln, Ravines, High Salinity, Ravine Based agricultural land, Water logged and Deep Water Table Lands. The major portion of the study area is barren and not suitable for agriculture. Agriculture is associated with only Water Logged areas. Thus only 15 % of the land is suitable for agriculture. Sub surface water logging could be identified as the major constraint to crop production. The water logging reduced the ear number and hence is the major contributor towards the yield difference. The ear numbers accounted for 66.6% of yield differences in cereals.

The Introduction of the canal system in Jhajjar District is mainly responsible for the existing water logging condition and soil salinization in 16% of the area. This is due to rising water table of saline water in major parts. Though this problem has assumed a serious proportion yet it is still possible to tackle it with careful planning. The Water Level Fluctuation in the area free from water logging is about 5m and in the water logged area the Water Level Fluctuation is very small amounting to 10-15cm. After establishment of HR-SEZ, there would be a requirement of 400-500 MLD of water. This would create a ground water trough in the region. Water logging can be removed due to this. The water level fluctuation in these areas would increase. For every 1m increase in Water Level Fluctuation, there would be about 33% increase in crop yield. Therefore for 5m increase in Water Level Fluctuation, there would be further increase in crop production. Apart from this after development of HR-SEZ, the amount of recycled water would be 480 MLD, which can irrigate much greater area than is possible presently. The quality of this water would be high in nitrogen and phosphorous which would increase the fertility of the soil which ultimately increase the crop production and types. In this way the creation of HR SEZ will not only beneficial to the Industrialist but also good to the farmers in the surrounding areas..

1.Introduction

India's largest private sector group company Reliance Industries, and the Haryana State Industrial and Infrastructure Development Corporation Ltd (HSIIDC), signed a joint venture to set up a multi-product Special Economic Zone (SEZ) in Haryana, India. The SEZ will come up near National Highway number 8 in Gurgaon - a satellite township of the capital - and would extend to Jhajjar district adjacent to the proposed Kundli-Manesar-Palwal expressway. The project will be India's largest SEZ spreading over 25,000 acres. The venture would capitalize Rs 1 lakh crore investment and is likely to generate about five lakh jobs, which is 25% jobs for the people in Haryana. The project would add Rs 10,000 crore a year to Haryana's revenue.

The focus of the zone is on environment-friendly medium and large industries; export houses, business and knowledge process outsourcing companies and research laboratories and institutions. Apart from this, hospitality and leisure destinations, educational institutions, offshore banking and insurance, and medical tourism also figure high on the priority list of this special zone.

Out of the 25,000 acres land in the SEZ, Industrial units would account for the bulk of the land and would be allotted up to 25% of the total area. Commercial establishments would be set up on 20% of the land, while 15 percent of the area is for residential units. The detailed distribution of land covers the low polluting units which will occupy 6,500 acres, commercial establishments 5,000 acres, infrastructure projects 5,000 acres and residential units 3,750 acres. About 1,250 acres would be set aside for recreational facilities. The HR-SEZ are after development would require 400-500 MLD water. The proposed SEZ would be the largest project of its kind in the country being designed on the pattern of the renowned Special Economic Zones in China and Dubai. This project is expected to give a fully sustained township with its own power plant, schools, colleges, banks, and one of India's biggest medical institutes. In the districts of Jind, Rohtak, Jhajjar districts groundwater has not been exploited because of its salinity problem. As a result, the water level has come to rising trend. According to Goel and Kumar (2000), this situation arises due to the network of canal system. This results in the water logging of the areas. In course of time more and more areas will fall under water logged area because of the presence of canals and their sub-branches network. Consequently, the soil fertility in these areas decreases.

The present paper deals with this problem and tries to formulate the remedy by sufficient exploitation of the groundwater.

2.Analysis And Discussion

2.1.Location And Areal Extent

The study area lies both in the Gurgaon and Jhajjar districts of Haryana (Fig. 1). It extends from National Highway number 8 (Gurgaon district) to the proposed Kundli-Manesar-Palwal expressway (Jhajjar district). The area has got mainly barren lands with a very small amount of covered area.

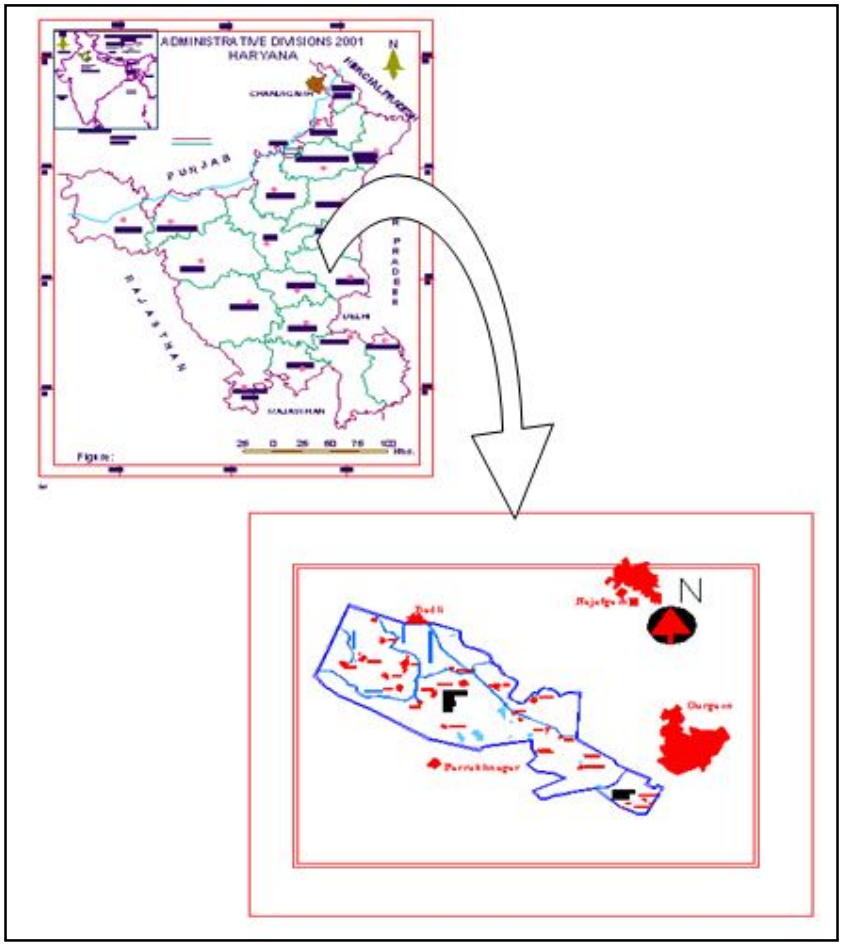

Figure 1

2.2.Physiography

The area forms a part of Indo-gangetic alluvial plain as observed from the Fig 2. Alluvial plains mark the overall topography of the HR-SEZ with undulating sand dunes occurring at places. Sand dunes are generally 3- 10 meters in height. Few sand dunes with high vegetation are fixed while some keep shifting depending upon the prevailing direction of the wind. The sand dunes comprise of buff colored medium to fine grained sand and are generally unsaturated.

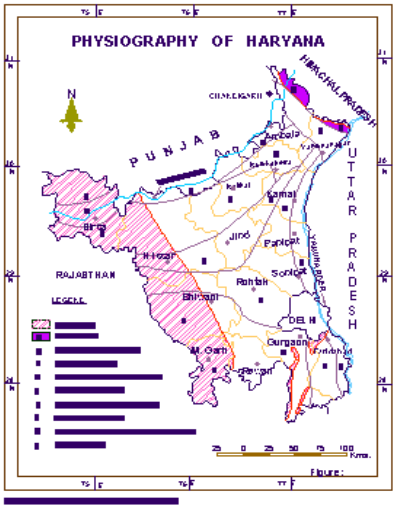

Figure 2

During extraction of groundwater, this character helps in drawing water from the adjacent waterlogged areas easily.

2.3.Drainage

The water-logging problem of the area has been aggravated by the natural flow of the ground water (Fig 3) and non-existence of any natural drainage basin or the outlet.

Adjacent to the study area, a number of small streams originate from the hill ranges that occur in the central part of the Gurgaon district. These water bodies over here do not meet any major stream or river but disappear in the permeable deposits of alluvial plains after traversing some distance. Mainly dendritic, sub-parallel to sub angular drainage pattern is observed. Sahibi river which is ephemeral in nature is the only major stream flowing in the south of the study area. This river originates in Jaipur district of Rajasthan and flows through Alwar, Rewari districts and then flows through Rohtak district before entering the Najafgarh jheel in Delhi.

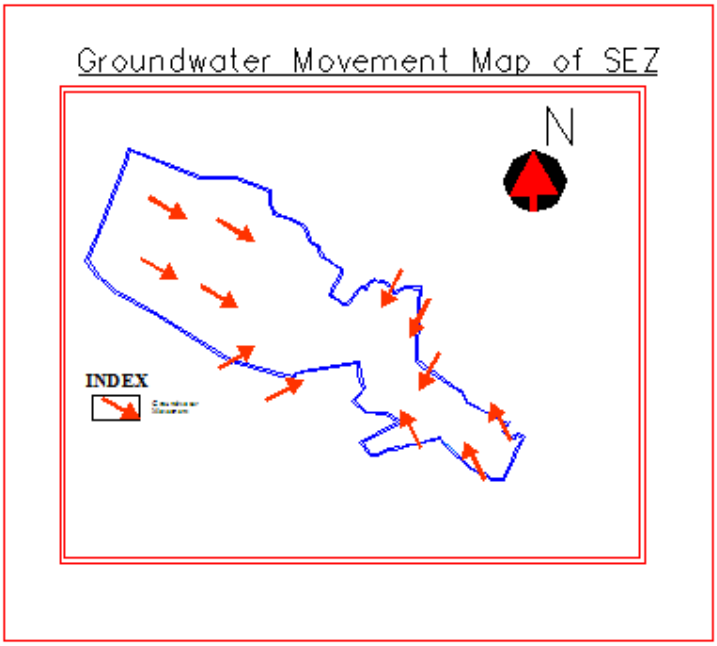

Figure 3

2.4.Climate & Rainfall

The climate of the present area is sub-tropical semiarid, continental and monsoon type. It is characterized by the dryness in air except during monsoon, a hot summer and a cold winter. The whole year may be broadly divided into four seasons, viz. winter, summer, monsoon and the post monsoon or the transit period. The winter starts late in November and continues up to the beginning of March. The summer is from March till the end of June. The weather during May and June is dry. The maximum temperature reaches up to 45^0C while in winter season minimum temperate falls up to 4^0C in the month of January. Sandy dust cyclones are common in summer season. Southwest monsoon prevails between July to mid September. The average annual rainfall is 492 mm in Jhajjar district and 540 mm in Gurgaon district. The post monsoon or the transition period prevails between mid September to end of November.

2.5.Geology

The stratigraphic succession of the area has Precambrian meta-sediments at the base. This belongs to the Delhi Super Group. The Quaternary Indo-gangetic alluvial plain overlies the basement rock. Quaternary Alluvium comprising of clay, sand and Kankar mixed in different proportions. The aeolian deposits of Sub-Recent age cap the plains. There is no exposure of the basement rock in the area. The stratigraphic succession along with water bearing capacity of each System is described in Table 1. From the Table, it is observed that only the newer alluvium has good water bearing zones. Other Stratigraphic Units show low to moderate permeability and yield small to moderate brackish to saline water. Geology of Haryana as a whole is described in Fig 4.

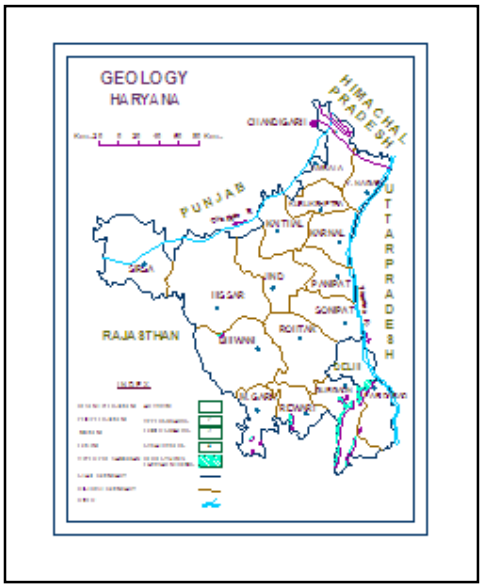

Figure 4

System	Series	Stratigraphic Unit	Lithological Character	Water bearing Characteristics
		Wind blown sand	Buff colored medium to fine grained sand	Generally Unsaturated
Quaternary	Pleistocene to recent	Newer Alluvium	Stream laid sand, Silt clay and gravel	Good water bearing horizons
		Older Alluvium	Poorly sorted semi consolidated, Silt, Sand and gravel	Low to moderate permeability yields small to

		with Clay & Kankar	moderate, brackish to saline water
Delhi	Ajabgarh	Slate phyllites, Quartzites Mica Schists with intrusive Pegmatites	Low to moderate permeability yield small quantity through joints and fracture
	Alwar	Quartzites Mica Schists with intrusive Pegmatites	yield small quantity through joints and fracture and bedding planes when present in the zone of saturation
----------Unconformity----------			
Aravalli (Archaeans)		Mica Schists, Crystalline limestone, Quartzites and Schistose conglomerate	Low permeability through fractures & Joints

Table 1: General Geological Succession and water bearing prosperities in the study area

2.6.Hydrogeology

As observed in the previous paragraph, the newer alluvium is the main reservoir of ground water. Granular zones of sand, which occur inter-bedded with clays in alluvium formation, form the main aquifer system. The deeper aquifers in the region occur in confined condition and shallow aquifers in unconfined condition.

Shallow aquifers in the district are either in the form of thin isolated lenses embedded in the clay beds or Kankar beds associated with silt and clays in different proportions. They are known to exist down to 70 m at places. The granular zones have pinching and swelling disposition and are found at localized thin isolated patches. The thickness and saturation of these lenses make frequent variations in the discharges of the shallow ground water structures. Groundwater in shallow aquifers are exploited through shallow tube wells where as deep aquifers are exploited by medium tube wells.

The depth to water level in Jhajjar district varies from 1.25 m to 21.55 mbgl but in most parts of the district it lies generally around 7.0 m below ground level. The general slope

of water in this district is converging towards the center of the district or more precisely around Jhajjar.

The long-term analysis of water level suggests that water level is rising in different blocks of the district show a rising trend in the last 27 years. It is observed that in Jhajjar Block the rate of rise is about 0.21 m per year, resulting in the rise of 6 m during last 27 years. This continuous rise in water level over few patches in this district has adversely affected the soil cover and quality of groundwater.

The nature of aquifer system of Gurgaon district is similar. The water table is deeper in the northern part and gradually becomes shallower towards the south. The part of the district, in the vicinity of the study area, shows a declining water table. The Gurgaon block shows a sharp decline from 0.88 to 2.80 m in the past 10 years. Hence the block has more draft than recharge.

The Groundwater moves from all the directions towards the HR-SEZ area (Fig 3). Hence water logging is very common feature in this region. Fresh water is confined to 60-100 feet in waterlogged zones and 40-100 feet in good aquifer zones. Najafgarh Drain, Gurgaon Water Supply Channel and Jahangir Minor are some of the important features in the area. The area lies close to the Jawahar Lal Nehru Canal and Western Yamuna Canal. Apart from this there are many distributaries flowing adjacent to the area. Presently the water level has reached 4-36 feet. If fresh water is not available up to an optimum depth then in due course of time the cone of tube wells of current tube wells will merge with the salinity zone. This necessitates the recharging of groundwater in a designed way.

The depth to water level map of the study area (Fig 5) shows that the area can be divided into 4 zones: 25-35 m b.g.l, 15-25 m b.g.l., 5-15 m b.g.l. and less than 5 m b.g.l. The last zone denotes the area where water logging is very prominent.

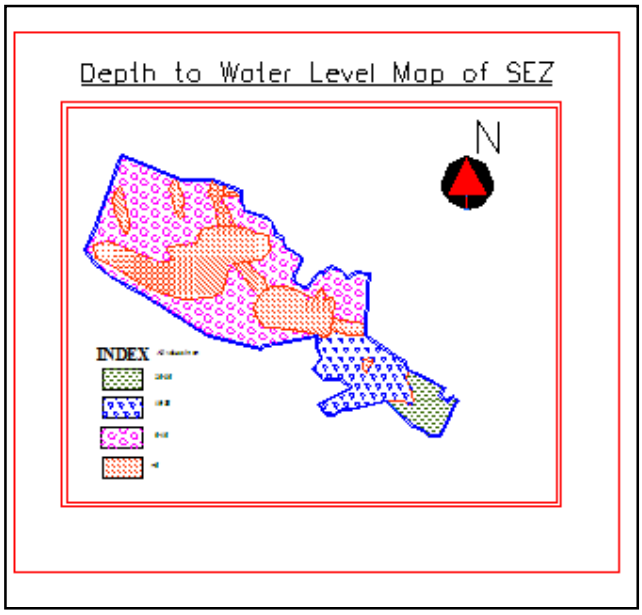

Figure 5

2.7.Canal Irrigation, Water Logging And Agriculture

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 shortage raises the water table to near surface. In both the districts in most part of Jhajjar as well as in parts Gurgaon there is a dense network of canal system for irrigation except in the area of HR-SEZ (Fig 6).

The experts maintain that the water logging effect on agriculture production is very serious. If the water table is too high, the land floods during the monsoon and the farmer cannot grow the Kharif crop. In case the upper layer of water is fresh or brackish, the subsequent Rabi crops, may be benefited. However, the benefit will not compensate for the loss to the Kharif crop, and with salinity build-up both the crops are lost

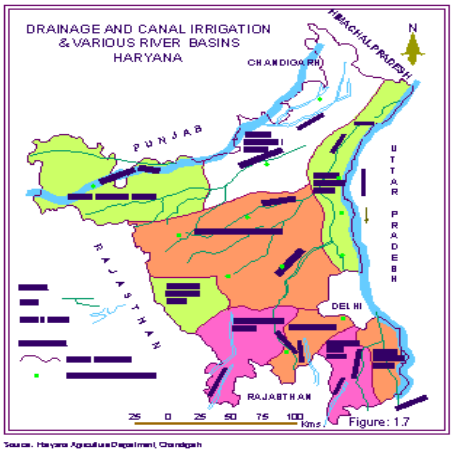

Figure 6

Before the introduction of the canal system in this region some farmers used to have open well where the water salinity was less at shallow depth but with the availability of canal water in plenty, these open wells were abandoned, thus reducing the pumping to zero level practically.

The Introduction of the canal system in south western part of the Haryana is mainly responsible for the existing water logging condition (Fig 7 a and b) and soil salinization due to rising water table of saline water in major part and sodic part in some areas. Though this problem has assumed a serious proportion yet it is still possible tackle it with careful planning.

For Jhajjar district, the area under water logging is 29700 hectare forming about 16 % of the district (Jamloki et al). Almost entire area out side the HR-SEZ is irrigated through Jhajjar sub branch of Jawahar Lal Nehru canal and distributaries in Jhajjar and Gurgaon canal in Gurgaon district. All most all the canal systems are lined but the lining is damaged due to poor maintenance. Water logging is observed associated with the irrigation sources and the canal command area. Paddy cultivation has increased by thirty two times for the last 14 years and this has added to the water-logging problem.

Since the ground water in most part of the area is brackish, its non-exploitation has posed a serious problem of rising of water table. Therefore the inadequate planning and execution of surface water resources without anticipating the drainage problem has questioned the sustainability of the present level of agricultural production in the state.

Hypoxia or low oxygen concentration is caused in the soils due to water logging. Accumulation of ethylene as well as other products of root and bacterial anaerobic metabolism is found due to water logging. In due course of time the influence of anaerobic organisms cause reduction of NO^{3-}, Mn^{IV}, Fe^{III} and SO_4^{2-} at successively lower redox potentials (Barret-Lennard, 2003).

Zhang et al., 2004 had shown experimentally that sub surface water logging could be identified as the major constraint to crop production. The water logging reduced the ear number and hence is the major contributor towards the yield difference. The ear numbers accounted for two thirds of yield differences in cereals.

In the study area if there is sufficient extraction of groundwater, the increasing water table in Jhajjar Block can be checked.

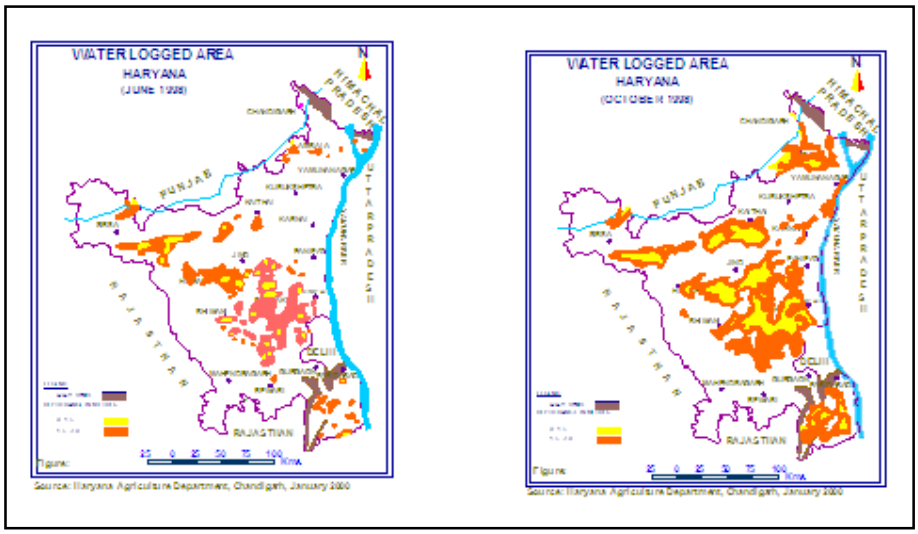

Figure 7 (a) *Figure 7 (b)*

The Water Level Fluctuation in the area free from water logging is about 5m and in the water logged area the Water Level Fluctuation is very small amounting to 10-15cm. After establishment of HR-SEZ, there would be a requirement of 400-500 MLD of water. This would create a ground water trough in the region. Water logging can be removed due to this. The Water Level Fluctuation in these areas would increase. For every 1m increase in Water Level Fluctuation, there would be about 33% increase in crop yield. Therefore for 5m increase in Water Level Fluctuation, there would be 165% increase in crop production.

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On the basis of Topography, Soil and Hydrological factors, the HRSEZ can be divided into following zones (Fig 8).

- Deep Water Table Land
- Ravines based Agricultural land
- Upland with Ravines
- High Salinity land
- Water Logged area
- Brick Kiln
- Ravines
-

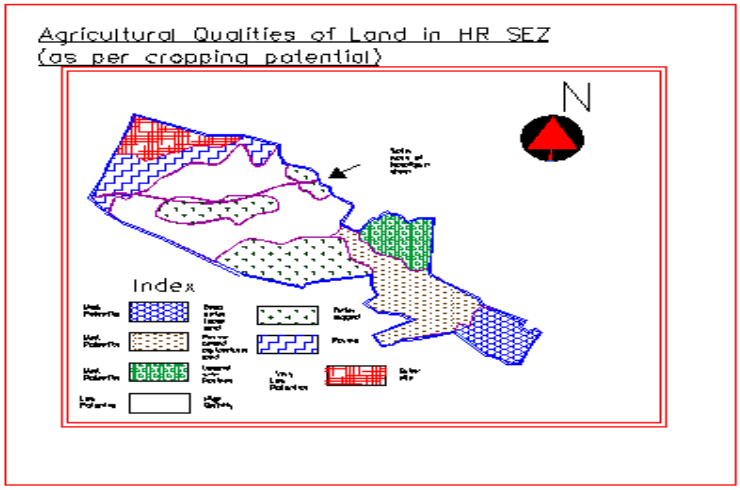

Figure 8

2.8.Deep Water Table Land

The perusal of the map indicates that there exist the Deep Water Table land in the Gurgaon part of the area The area has got the medium agriculture but due to deep water table which is acquired the decline trend by virtue of which the agriculture is only based on the rainwater since the cost of pumping is very high.

2.9.Ravines Based Agricultural Land

The areas around Najafgarh drain is mainly ravines in nature but some agricultural activity is taking place for growing of Bajra and wheat which may be economical due to amendment of fertilizers in huge quantity.

2.10.Upland With Ravines

The upland margin area around Kakori, Dryapur and other villages, where several drains are falling into the Najafgarh drain, is completely ravines land. Since these are undulating in character hence no cultivation is possible in these areas.

2.11.High Salinity Land

High salinity areas are found near the Jhajjar region and near Sultanpur lake regions due to rising Water table or Water Logging. Since the Electrical conductivity in these regions are very high and there is elevation of water table near the ground level, hence no agriculture is taking place in this area.

2.12.Water Logged Area

The water logging is a phenomenon where the Water table has almost approached to the ground level. The growth of the plant requires the presence of zone of aeration which has completely vanished due to approach of water table on the ground surface. This has reduced the agricultural activity drastically. Also the groundwater is brackish in this water logged area.

2.13.Brick Kiln

The northwest corner of the area shows the development of Brick Kiln. This area shows very low potential of agriculture.

2.14.Ravines

Just adjacent to the Brick Kiln area in the HR-SEZ, the Ravine area occurs. Agriculturally this area shows medium potentiality.

The Flood and its Waterways always erode the soil enroutes by virtue of which the soil loses its fertility and hence there is reduction of agricultural activity. The Flood routes of the local drains and the Najafgarh drain erode a good quantity of soil and due to this

erosion the agriculture is low .The above-mentioned cause is the basic reason for the low rates of agriculture in the HR-SEZ.

The agricultural activity can take place only in the water-logged areas only after amendment of the soil with large quantity of fertilizer. Thus only 15% of HR-SEZ area is suitable for agricultural activity.

2.15.Soil Characters

Overall the soil of the soil is arid brown (solonized) soil (Fig 9).

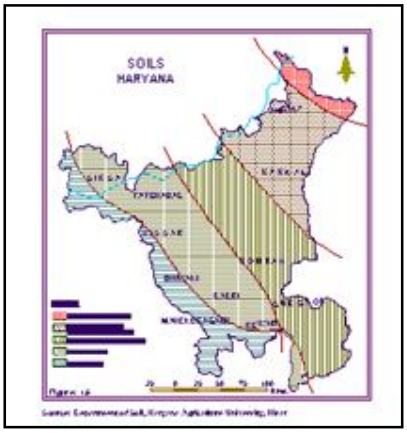

Figure 9

Salinity is greater hazard than alkalinity in the soil of Gurgaon district. Moderate soil salinity hazards occur in Nuh Firozpur Jhirka and Punhana Blocks. Moderate salinity and moderate alkalinity is observed in the soil of Gurgaon Block, slight salinity and alkalinity occur in Sohna block and slight salinity and high alkalinity occur in Pataudi Block. Thus the quality of soil varies from block to block. Sohna and Pataudi have very low quality soils whereas low quality soil occurs in Gurgaon block. The blocks of Punhana and Firozpur Jhirka have medium quality soils (Duggal S. L. 1979).

Only 8 % of Jhajjar District is affected by the problem of salinity and alkalinity. Jhajjar Block shows salinity hazard. The soil texture of Jhajjar district varies from fine to medium-grained. Sandy to clayey loam is observed in Salahwas and Matanhail blocks of Jhajjar district and sandy loam is observed in Bahadurgarh and Jhajjar blocks. Organic Carbon, Nitrogen and Phosphorus are low with medium to high Potash.

The following two Tables (2 and 3) show the land utilization in Jhajjar and Gurgaon districts.

Sl. No.	Particulars	Area in Hectare
1.	Total area	191000
2.	Barren and unculturable land	1000
3.	Land put to non- agricultural uses	20000
4.	Forest	0
5.	Culturable waste	13000
6.	Permanent pastures and other grazing land	0
7.	Land under misc. trees/crops	0
8.	Current fallows	2000
9.	Net area Sown	155000
10	Area sown more than once	78000
11	Total cropped area	233000
12	Cultivable area	170000

Table: 1 Land Utilization in Jhajjar district , Haryana
(Source: Ground water management studies in Jhajjar district, Haryana C.G.W.G North western region Chandigarh January 2006)

Sl. No.	Particulars	Area in Hectare.
1.	Total area according to village papers	270000
2.	Barren and uncultivable land	5000
3.	Land put to non- agricultural uses	48000
4.	Forest	3000
5.	Culturable waste	2000
6.	Permanent pastures and other grazing land	2000
7.	Current fallows land	24000
8.	Net area Sown	189000
9.	Area sown more than once	87000
10.	Total cropped area (8+9=10)	276000

Table: 2 Land Utilization in Gurgaon district , Haryana
(Source: Ground water resource and development potential of Gurgaon district, Haryana April 1999)

The Table No. 2 shows that major area of the district is under agriculture. The net area sown is 155000 hectares out of the total 191000 acres area. The Table No. 3 shows that major area of the district is under agriculture. The net area sown is 189000 hectares out of the total 270000 acres area. Due to non-availability of irrigation facility, only 87000 acres area is sown more than once, which is around 46% of the net area sown.

The soil character in Jhajjar Block is deficient in nitrogen and phosphorous. If by any means this soil can be manured by nitrogen and phosphorous fertlizer, then this area can be highly productive.

The study area shows the following statistics on irrigation:

After development of the HR-SEZ, the amount of water that can be used as recycled water is 480 MLD.

Now 1 acre of land requires 1 ML/year of water to irrigate.

Hence 480 MLD of water can irrigate 480 acres of land. Hence in a year 1,75,200 acres of land can be irrigated against a previous figure of 25,000 acres of land. The quality of water would be very high in nitrogen and phosphorous and hence can make the soil in the Jhajjar Block very fertile.

3.Conclusion And Recommendation

The study area lies both in the Gurgaon and Jhajjar districts of Haryana.

Alluvial plains mark the overall topography of the HR-SEZ with undulating and unsaturated sand dunes occurring at places.

The Groundwater moves from all the directions towards the HR-SEZ area. The water logging problem of the area has been aggravated by this natural flow of the ground water and non-existence of any natural drainage basin or the outlet.

The climate of the present area is sub-tropical semiarid, continental and monsoon type.

The stratigraphic succession of the area has Precambrian meta-sediments at the base. The Quaternary Indo-gangetic alluvial plain overlies the basement rock. The aeolian deposits of Sub-Recent age cap the plains. Only the newer alluvium has good water bearing zones. Other Stratigraphic Units show low to moderate permeability and yield small to moderate brackish to saline water.

Fresh water is confined to 60-100 feet in waterlogged zones and 40-100 feet in good aquifer zones. Najafgarh Drain, Gurgaon Water Supply Channel and Jahangir Minor are some of the important features in the area. The area lies close to the Jawahar Lal Nehru Canal and Western Yamuna Canal. Apart from this there are many distributaries flowing

adjacent to the area. Presently the water level has reached 4-36 feet. If fresh water is not available up to an optimum depth then in due course of time the cone of tube wells of current tube wells will merge with the salinity zone. This necessitates the recharging of groundwater in a designed way.

The constant rising water table of the brackish and saline ground water has created water logging and soil salinization condition.

When waterlogging reaches the root zone of plants, yields are drastically decreased because the roots need air to survive and they cannot survive in anaerobic conditioned (Wolman 1987).

The agricultural activity can take place only in the water-logged areas only after amendment of the soil with large quantity of fertilizer. Thus only 15% of HR-SEZ area is suitable for agricultural activity.

The soil character in the Jhajja Block is deficient in nitrogen and phosphorous. If by any means this soil can be manured by nitrogen and phosphorous fertlizer, then this area can be highly productive. After development of HR-SEZ, the amount of recycled water would be 480 MLD, which can irrigate much greater area than is possible presently. The quality of this water would be high in nitrogen and phosphorous which would increase the fertility of the soil.

The Water Level Fluctuation in the area free from water logging is about 5m and in the water logged area the Water Level Fluctuation is very small amounting to 10-15cm. After establishment of HR-SEZ, there would be a requirement of 400-500 MLD of water. This would create a ground water trough in the region. Water logging can be removed due to this. The Water Level Fluctuation in these areas would increase. For every 1m increase in Water Level Fluctuation, there would be about 33% increase in crop yield. Therefore for 5m increase in Water Level Fluctuation, there would be 165% increase in crop production.

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To avoid water logging and salinity of the groundwater in and around the study area, withdrawal of enough groundwater should be done. This is only possible if pumping is done in sufficient amount in the proposed HR-SEZ area. After development of the study area large quantity of water would be necessary. This would lower the rising water table from the surrounding area producing a ground water trough in the region. The effect of

this would be far reaching as the surrounding area can show increased agricultural activity.

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