1.PREFACE:

The Ministry of Environment, Forest and Climate Change (MoEF & CC) has several policy initiatives and enacted environmental and pollution control legislations to prevent indiscriminate exploitation of natural resources and to promote integration of environmental concerns in developmental projects. One such initiative is the Notification on Environmental Impact Assessment (EIA) of developmental projects issued on 14th September,2006 under the provisions of Environment (Protection) Act,1986, making EIA mandatory for certain categories of developmental projects.

Minerals are classified into two groups, namely (i) Major minerals and (ii) Minor minerals. Amongst these two groups, minor mineral has been defined under section 3(e) of Mines and Minerals (Regulation and development) Act, 1957. The minor minerals are further governed by Punjab Minor Mineral Rules, 2013 in this report.

On mining of minor mineral, it is mandatory to have District Survey Report (DSR) by MoEF & CC vide their Notification No. 125 (Extraordinary, Part II Section 3, Sub-section ii), S.O. 141 (E), dated 15th January 2016. This will ensure environmentally sustainable mining for minor mineral under close supervision of district authorities. The notification was made to bring certain amendments with respect to the EIA notification 2006 and in order to have a better control over the legislation, district level committee's for introduced in the system. Preparation of District Survey Reports has been introduced as a part of the above notification. Subsequently, MOEF & CC has published Notification No. 3611 (E), dt. 25th July, 2018 regarding inclusion of the "Minerals Other than Sand" and specified the format of the DSR. Monitoring Guidelines for Sand Mining (EMGSM) January 2020, issued by Ministry of Environment, Forest and Climate Change is prepared in consideration of various orders/directions issued by Hon'ble NGT in matters pertaining to illegal sand mining and also based on the reports submitted by expert committees and investigation teams. This DSR has been prepared in conformity with the S O 141 (E), S O 3611 (E) and other sand mining guidelines published by MOEF & CC time to time.

A detailed procedure and format for preparation of District Survey Report (DSR) has been discretely discussed under Para 7(iii) (a) and Annexure (x) of the notification issued by Ministry of Environment, Forest and Climate Change, Government of India on 15th January, 2016. In sort, the purpose is to ensure that mining of minor mineral is done in environmentally sustainable and socially responsible manner. It also helps to identify the areas of deposition where mining can be permitted and also, to identify the areas of aggradation & erosion, to monitor river equilibrium and helps to protect and restore the ecological system. The DSR would also help to calculate the total amount of replenishment, where ever applicable.

Preparation of this DSR required both primary and secondary data generation. The primary data has been generated by the site inspection, ground truthing, survey etc. while secondary data has been generated through various authenticated sources and satellite imagery studies. District survey report also covers the area of General information of the district, Demography, Geomorphology, topography, Forest and Agricultural information, climate condition, rainfall details, Land use pattern, cropping pattern. The DSR would also help to calculate the total amount of replenishment, where ever applicable.

Disclaimer: The data may vary due to flood, heavy rains and other natural calamities. Therefore, it is recommended that DEIAA/SEIAA may take into consideration all its relevant aspects / data while scrutinizing and recommending the application for EC to the concerned authority.

CHAPTER 2: INTRODUCTION

2. INTRODUCTION

The Moga district is positioned at the center of the Punjab state. It is the 17^{th} district of the Punjab State formed in 1995. It was previously a tehsil of Faridkot. The new district Moga was formed after the joining of the Moga tehsil and Bagha Purana tehsil. This place has had great historical importance since, ancient times. This district was named after the district Head Quarter the Moga city which was named after the Moga Singh, the person of great importance among the Wadan Gils (Wadan Gil is a section of twelve Gils). This district also witnesses many important periods of history, from the Indus valley civilization to the struggle for independence. Various kinds of pottery were found here from some sites at the time of explorations. In the Medieval Period, this area was under the power of Muhammedans, in the hand of Isa khan who was the actual founder of Faridkot. At the time of the freedom movements, people of the district Moga raised against the British and started the 'Struggle for Freedom'. At the time of independence in 1947, Moga tehsil was free from British rule.

Moga district lies between 30°35' to 31°15' north latitude and 75°15'to75°25' east longitude. The area of this district is 2242 Sq. Km. This district is surrounded by Jalandhar in the northeast, Ludhiana in the east, Barnala in the southeast, Bathinda in the south, Faridkot in the southwest, and Ferozepur in the northwest. The district Head Quarter Moga town is positioned on Ferozpur-Moga-Ludhiana Road. This district is under Ferozpur jurisdiction.

The concept of Green field theory and in some places, the concept of Brown field theory was taken into consideration to prepare the District Survey Report (DSR) of SAS Nagar district of Punjab with the aim of depicting the history of overall geology followed by the disposition of different types of litho-units and geological succession as well. The entire geological report encompasses the history of riverbed and river bank sand deposition.

Table 1: DSR guidelines over the years

Year	Particulars
1994	The Ministry of Environment, Forest & Climate Change (MoEF&CC) published Environmental Impact Assessment Notification 1994 which is only applicable for the Major Minerals more than 5 ha.
2006	In order to cover the minor minerals also into the preview of EIA, the MoEF&CC has issued EIA Notification SO 1533 (E), dated 14th September 2006, made mandatory to obtain environmental clearance for both Major& Minor Mineral more than 5 Ha.
2012	Further, Hon'ble Supreme Court wide order dated the 27th February, 2012 in I.A. No.12- 13 of 2011 in Special Leave Petition (C) No.19628-19629 of 2009, in the matter of Deepak Kumar etc. Vs. State of Haryana and Others etc., ordered that "leases of minor minerals including their renewal for an area of less than five hectares be granted by the States/Union Territories only after getting environmental clearance from MoEF".
2015	Hon'ble National Green Tribunal, order dated the 13th January, 2015 in the matter regarding sand mining has directed for making a policy on environmental clearance for mining leases in cluster for minor Minerals.
2016	The MoEF&CC in compliance of above Hon'ble Supreme Court's and NGT'S order has prepared "Sustainable Sand Mining Guidelines (SSMG), 2016" in consultation with State governments, detailing the provisions on environmental clearance (EC) for cluster, creation of District Environment Impact Assessment Authority, preparation of District survey report and proper monitoring of minor mineral. There by issued Notification dated 15.01.2016 for making certain amendments in the EIA Notification, 2006 and made mandatory to obtain EC for all minor minerals. Provisions have been made for the preparation of District survey report (DSR)for River bed mining and other minor minerals.
2018	MoEF& CC published a notification S.O. 3611(E) Dated 25th July, 2018 and recommended the format for District Survey Report. The notification stated about the objective of DSR i.e., "Identification of areas of aggradations or deposition where mining can be allowed and identification of areas of erosion and proximity to infrastructural structures and installations where mining should be prohibited and calculation of annual rate of replenishment and allowing time for replenishment after mining in that area".
2020	Enforcement & Monitoring Guidelines for Sand Mining (EMGSM) 2020 has been published modifying Sustainable and Mining Guidelines, 2016 by MoEF&CC for effective enforcement of regulatory provisions and their monitoring. The EMGSM 2020 directed the states to carry out river audits put detailed survey reports of all mining areas online and in the public domain, conduct replenishment studies of river beds, constantly monitor mining with drones, aerial surveys, and ground surveys and set up dedicated task forces at district levels. The guidelines also push for online sales and purchase of sand and other river bed materials to make the process transparent. The guidelines propose night surveillance of mining activity through night-vision drones.

3. GENERAL PROFILE

a) General information

Geographically Moga district is an even land made of alluvium that was carried into the area at the time of the river's passing. This district has a little elevation of about 218 meters on average and from northeast to southwest directions. Sutlej sub-basin of the Indus basin and Indo-Gangetic plain forms the base of this district. Sutlej is one of the prime rivers that flows through the northern border of this district. This district is situated at the center of the Punjab state and is surrounded by Jalandhar, Ludhiana, Barnala, Bathinda, Faridkot, and Ferozepur districts.

This district has newly made in 1995, by adding the Bagha Purana tehsil with the Moga tehsil of the Faridkot district. Before that, it was a part of the Firozpur district. This district lies between 30°35' to 31°15' north latitude and 75°15' to 75°25' east longitude. The area of this district is 2242 Sq. Km. This district is named after the district Head Quarter Moga town which is placed on Ferozpur-Moga-Ludhiana Road.

Administratively, the Moga district is divided into four tehsils: Moga, Baghapurana, Nihal Singh Wala, Dharmkot, and four sub-tehsils: Ajitwal, Smalsar, Badhni Kalan, Kot-Ise-Khan. The district has five blocks: Moga-I, Moga-II, Baghapurana, Nihal Singh Wala, and Dharmkot. This district is under Ferozpur jurisdiction.

This district has 322 villages and 6 towns according to 2011 census data. Moga had a population of 9,95,746 people in 2011, with 5,25,920 males and 4,69,826 females. According to provisional data released by Census India in 2011, the population density of Patiala district in the year 2011 is 444 people per square kilometer.

Table 2: Administrative units of the district Moga

Administrative Units	Year	Unit	Statistics
i) Tehsils /Sub divisions	2011	Nos.	4
ii) Sub-Tehsil	2011	Nos.	4
iii) Blocks	2011	Nos.	5
iv) Panchayat Simitis	2011	Nos.	6
v) Nagar Nigam	2011	Nos.	-
vi) Nagar Palika	2011	Nos.	-
vii) Gram Panchayats	2011	Nos.	344
viii) Inhabited villages	2011	Nos.	317
xi) Assembly Area	2011	Nos.	4

b) Climate condition

The district Moga is normally very hot in summer and typically cold in winter. The summer starts here in March and continues till June. By that time hot winds blow all the time. Sometimes dust storms also happened during this season. The temperature generally touches 40°C or more than that. The rainy season comes after that. It starts in the middle or end of June and lasts for the middle of September. The hot climate gets drops off the temperature due to rain. The rain helps to lower the temperature. But if it is not raining during the monsoon time it will be terrible due to the high temperature. Mid-September to November is the post-monsoon or transitional period of climate. This time, the weather becomes very comfortable during October. In December, the temperature lowers at night. This time a huge difference in the temperature of day and night is noticed. January and February are very cold here. Sometimes temperature reaches the freezing point or below the freezing point. The coldest month is January when the temperature drops to 5°C.

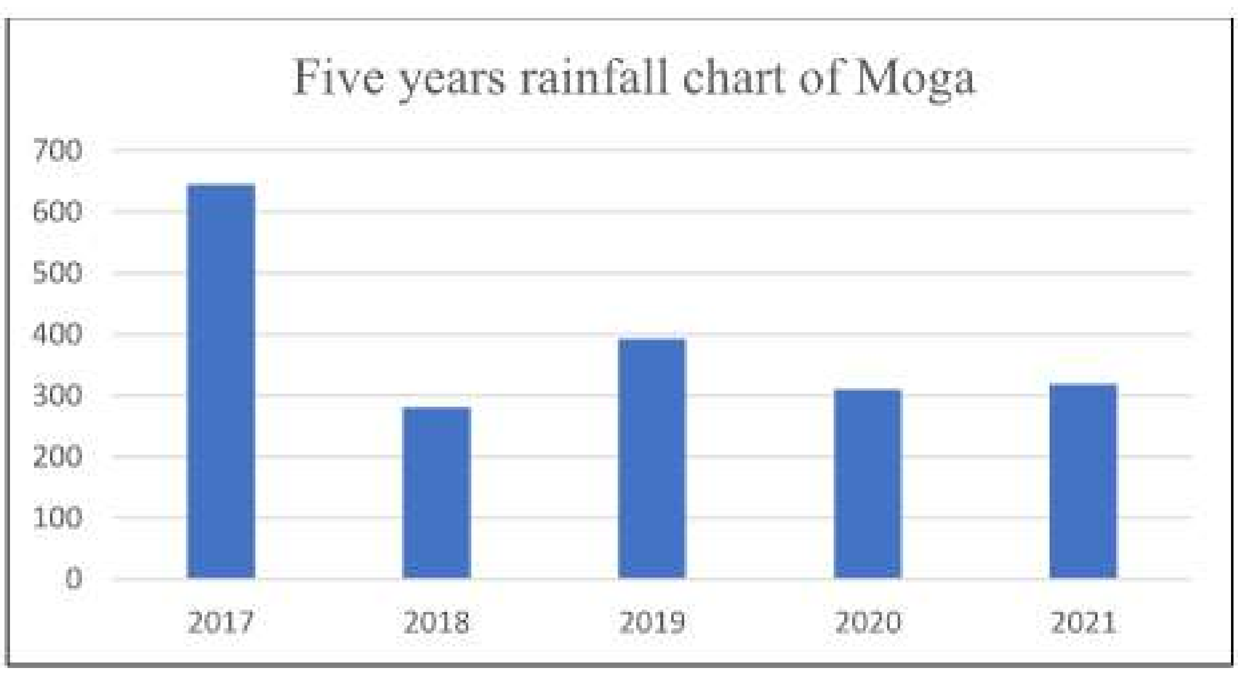
c) Rainfall (month wise) and humidity

The district of Moga typically experiences 498 mm of rain annually for 24 days. The southwest monsoon contributes 70% of the annual rainfall. Rainfall in the district tends to increase from the southwest to the northeast.

Table 3: Last five years of rainfall data of Moga district

Sr. No.	Year	District	Total (mm)
1.	2017	Moga	644.8
2.	2018	Moga	280.2
3.	2019	Moga	392.9
4.	2020	Moga	310.2
5.	2021	Moga	318.6

Chart 1: last five years' total rainfall chart of Moga district



During the monsoon, the relative humidity is high, averaging around 60.5%. Overall, the average relative humidity of the district is 40.51%.

Table 4: Average relative humidity of district Moga

Month	January	February	March	April	May	June	July	August	September	October	November	December	Year
Average relative humidity (%)	54.61	56.98	46.55	25.8	18.78	25.2	46.22	60.5	54.54	32.39	28.38	36.12	40.51

d) Topography and Terrain

Topographically this district is flat, even land. The average elevation of this district is 218 meters. Whereas, 227 meters at the northeast point and 209 meters southwest end. So, the slopping pattern is from northeast to southwest direction. This district is made of alluvial plains that come with the river flow and are deposited in this area. Normally the upper portion of the land of this area looks plain but actually, some small sand dunes can be seen here. Only small sand dunes can be seen in some places. River Sutlaj passes through the northern region of this district.

e) Water Course and Hydrology

River Sutlaj is the main river of this district which passes only through the northern part of this district. After passing this district it flows to the left and joined Beas. Moga Nala can only be found after rainy seasons in this district. It originates in Ludhiana District and after flowing into this district it goes to the Faridkot District. Its course path is as same as the course path of the Sutlaj river.

f) Ground Water Development

The groundwater of this region is fresh to marginally saline in the presence of shallow aquifers. The aquifer of this area is $NaHCO_3$ There is a certain parameter for safe drinking water as per BIS norms 2007. A many anions bicarbonate is the dominant anion and among cations Na one dominant. Salinity (EC) Sodium Adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC) are the basic parameters considered for ascertaining the irrigational suitability of groundwater. After the analysis of groundwater, it is found that the groundwater of this region falls under C3 S4 and C3 S1 classifications. Which is high in salinity and sodium concentration and is not suitable for irrigation. Sometimes fluoride concentration, Iron concentrations are higher than permissible limits. In some parts of block Moga-II and Bhagapurana the Sodacity and Salinity levels are alarming. But the groundwater of the rest of the aris are suitable for irrigation as well as domestic use.

Table 5: Block-wise Groundwater Resource of Moga district as on 31.03.2013

Block Name	Net Annual Ground Water Availability (MCM)	Existing Gross Ground Water Draft for irrigation (MCM)	Existing Gross Ground Water Draft for all uses (MCM)	Allocation for domestic and industrial requirement supply uptonext25years (MCM)	Net Ground Water Availability for future irrigation development (MCM)	Stage Ground Water Development (%)	Category
BHAGA PURANA	36917	61378	61801	581	-25042	167	OVER-EXPLOITED
DHARAM KOT (KOT ISA KHAN)	31558	57616	57959	472	-26529	184	OVER-EXPLOITED
MOGA I	19555	45792	46357	777	-27014	237	OVER-EXPLOITED
MOGA II	15746	34413	34616	279	-18946	220	OVER-EXPLOITED
NIHAL SINGH WALA	16796	42948	43217	269	-26422	257	OVER-EXPLOITED
TOTAL	**120572**	**242148**	**243949**	**2378**	**-123953**	**202**	OVER-EXPLOITED

g) Drainage system (general)

Sirhind Canal is the Largest Canal System in Punjab, by which irrigation system has been made simpler. It helps in the irrigation system in the Malwa region. Abohar Branch of Sirhind Canal comes into the district from the Ludhiana side. This canal was first made by the British People in association with the Princely States in the Rupnagar district from Sutlaj river. This canal passes through the Moga district and helps in the irrigation system also.

h) Demography

According to census data in the year 2011, the district of Moga had a population of 9,95,746 in 2011, with 5,25,920 males and 4,69,826 females.

Table 6: Moga District Table Data

Description	2011
Population	9,95,746
Actual Population	9,95,746
Male	5,25,920
Female	4,69,826
Population Growth	11.3%
Area Sq. Km	2242
Density/km2	444
Proportion to Punjab Population	35.85%
Sex Ratio (Per 1000)	895
Child Sex Ratio (0-6 Age)	843
Average Literacy	83.8
Male Literacy	87.9
Female Literacy	79.2

Chart 2: Male and female population of Moga district

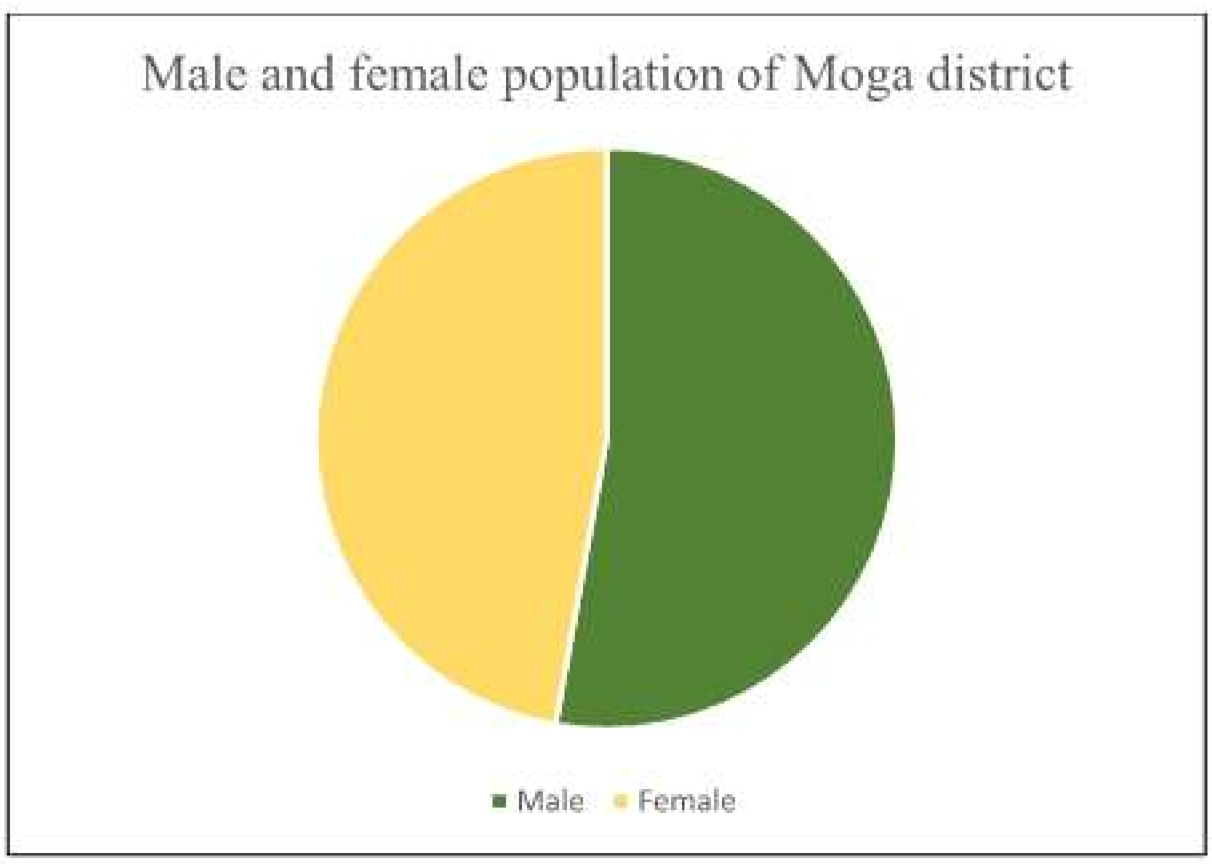


Chart 3: Male and female child population (0-6 years) of Moga district

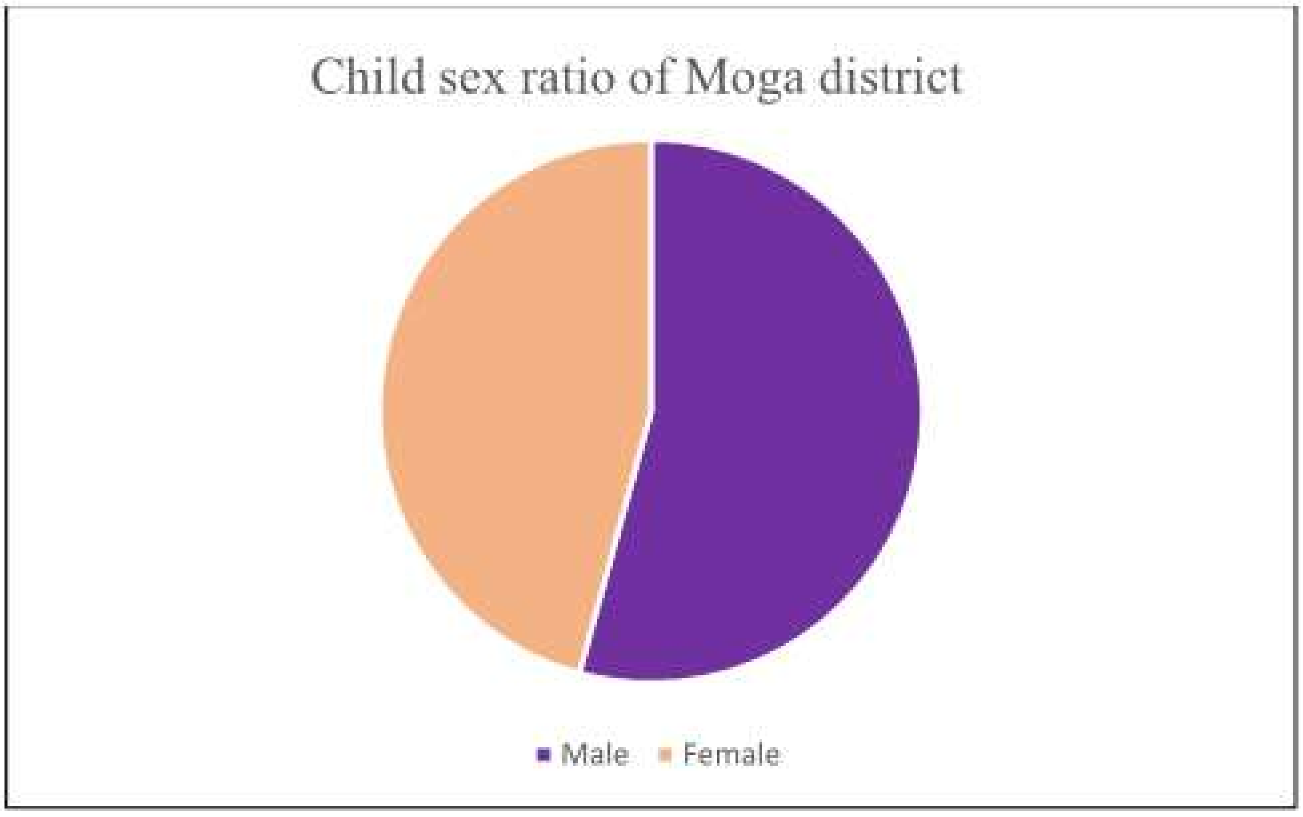


Chart 4: Moga district's literacy rate

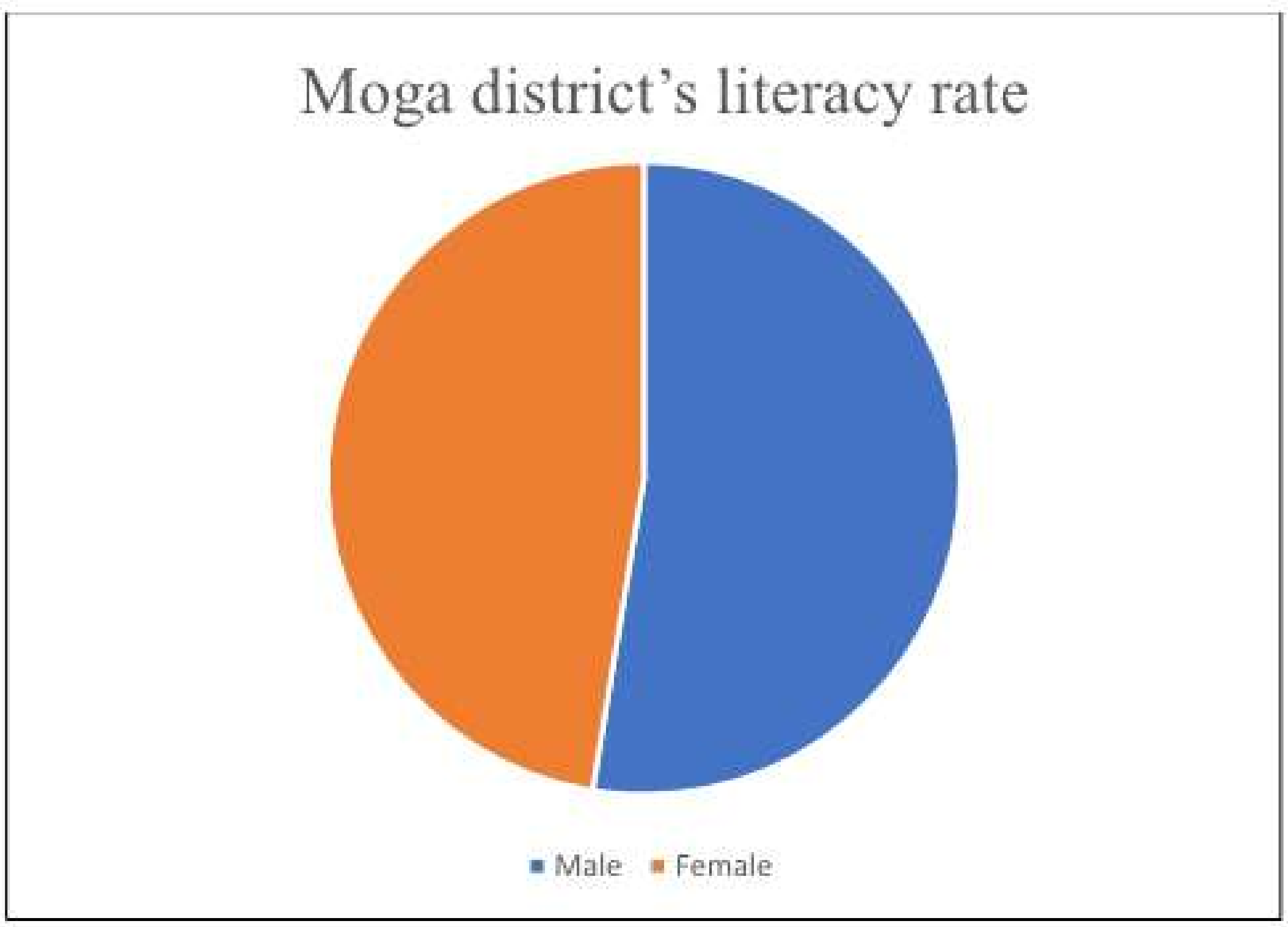


Table 7: Tehsil Wise Population Statistics of District Moga as per Census 2011

Name of Tehsil	Rural Male	Rural Female	Rural Total	Urban Male	Urban Female	Urban Total	Grand Total
Nihal Singhwala	86,689	77,134	163,823	3,596	3,190	6,786	**170,609**
Bagha Purana	105,936	94,507	200,443	13,288	11,918	25,206	**250,855**
Moga	213,079	191,155	404,234	103,332	91,922	195,254	**599,488**
District Total	**405,704**	**362,796**	**768,500**	**120,216**	**107,030**	**227,246**	**995,746**

i) Cropping pattern

Agriculture is one of the prime sources of income in this district. About 77.2 % of the rural population is depending on agriculture. The main cropping seasons of this district are Kharif (sawni) and Rabi (hari). Harvesting is done in those cropping seasons. The main Kharif crop is Rice (paddy) which grows is a large scale here. According to census data, 812 thousand metric tons of rice were produced during 2009-2010. Maize, Groundnut, Sugarcane, Cotton, Pulses, Chillies, etc. are also cultivated during the Kharif season. Wheat is the main crop that is produced here in the Rabi seasons. During 2009-2010, 779 thousand metric tons of wheat were produced here. Other crops that are grown in the Rabi seasons are Gram, Barley, Potatoes, and Oilseeds. Apart from those pulses and oilseeds, a good portion of vegetables is also produced here.

j) Landform and seismicity

This district is made of an alluvial plain. So, the landform of this district is normally even. But small sand dunes can be seen in some places in this district. The average elevation of this district is 218 meters from northeast to southwest directions. Depending upon the landform pattern the district can be divided into four types, Upland plain, Sand dune tract, younger flood pain, and active flood plain of Sutlaj.

Seismologically, the Moga district falls under seismic zone IV. Zone IV is considered the high-damage risk zone in relation to earthquakes.

k) Flora

Flora is the common plant that is found here are consists of various herbs, shrubs, and trees. The plants that are found here mostly are: *Salvadora oleioides* Dene (van, mal), *Capparis decidua* (Forsk.) Edgew, *Acacia nilotica* (L.) Wild. ex DC. Subsp. indica (Bth.) Brenan (kikar), *Prosopis cineraria* (L.) Druce (Jand), *Prosopis cineraria* (L.) Druce (Jand), *Dalbergia sissoo Roxb.* (shisam or tahli), *Albizia leddeck Bth.* (siris), neem (*Azadirachata Indica Zucc.*) and the Bukain or Persian lilac (Melia, azedarch L.). The presence of Akk (*Calotropis procera)* is very common all over the district. The common fruits that are noticeable here are mangoes, oranges, lime, citrus, pomegranate, jaman, and bananas.

l) Fauna

The fauna consisted of the local animals. The nilgai is found in field areas of the Moga Tehsil and the hog-deer is also found here. Sometimes wolfs and wild boars are also seen here. Jackals are common in the riverain tract and in the neighbourhood of towns but are very rare in the uplands. The fox is found in the sandy parts of the district, whereas the hare is common. The otter is sometimes found along the river and near the large jheels. In the River itself, the tortoise is common.

Some common birds that can be seen here are doves, crows, sparrows, starlings (mains), and parrots. The black partridge (*Francolinus francolinus*) is common in the riverain tract, whereas the grey partridge (*Perdix perdix*) is found in almost all places. In the sandy parts of the district sandgrouse (*Pteroclidae*), both the imperial and common varieties, are found the former being especially plentiful in the cold weather. At the beginning of the cold weather, large flocks of the eastern stock pigeon visit the district.

4. PHYSIOGRAPHY OF THE DISTRICT

a) General Land Form

The Moga district is the 17th district of Punjab and it is positioned at the midpoint of the state. Earlier it was under the Firozpur district, then it became a subdivision of the Faridkot district. Later, in 1995 the Moga district was made by adding Bagha Purana tehsil with the Moga tehsil. Moga district is situated between 30°35' to 31°15' north latitude and 75°15' to 75°25' east longitude. As the district is located at the center of the state, it is totally surrounded by other districts of Punjab. Jalandhar, Ludhiana, Barnala, Bathinda, Faridkot, and Ferozepur covered up the district.

The landform of this district is normally plain with a little slope from northeast to southwest directions. The highest elevation in the northeast direction is 227 meters and the lowest elevation in the southwest direction is 209 meters. The average elevation of this district is 218 meters. This area is made with the Indo-Gangetic plain and Sutlej sub-basin of the Indus basin. This area can be divided into four types, depending on the landform is; Upland plain, Sand dune tract, younger flood pain, and active flood plain of Sutlaj. River Sutlaj is an important river that flows along with the northern border of the district.

b) Soil and Rock Pattern

This district is formed with the flat alluvial plain that was carried out at the time of river deposition which characteristics the whole of Indo Gangetic plains. The soil of this region is very deep. Soil is sandy loam to silty clay loam in texture. The drainage system of the soil is well to moderately well. But the fertility level of the soil is low to medium. Soils of this district in most of the regions are highly potential, productive, and fertile. The productivity of the soil depends on the soil, water, and air relationship. Mainly two kinds of soils can be seen here, Sierozem and Desert soils.

c) Different Geomorphological Units:

Moga district is made of flat alluvial plains, which are deposited as a fresh deposition of rivers. This area is the intermedium part of the Ghaggar rivers. So, this area shows the characteristics of Indo Gangetic plains. Normally the surface area looks even but after analysis under a microscope, smaller differentiation can be noticed in the topography of the land. Due to the position, sand dunes or sand are found in some areas of this district. But no continuous tract of sand or sand dunes is found here. Only some small sand ridges are be seen but most of them are now normalized. The deposition of river Sutlaj and Ghaggar rivers nourish the land very well. River Sutlaj now changes its path slightly from the previous path and flows parallel with the northern boundary.

Rivers

River Sutlaj is one of the important rivers in this district. The Sutlaj crosses this area, flows northernly this area, and joined with the river Beas. Another important river is Moga Nala. It is a rainfed river, water can be found in only rainy seasons. It comes into the district from Ludhiana District and flows westerly through Moga city and passes into Faridkot District. Its course is just like Sutlaj.

5. LAND USE PATTERN OF THE DISTRICT

➢ Introduction

- **Land cover** is the physical material at the surface of the earth. Land covers include grass, asphalt, trees, bare ground water, *etc*. Land cover data documents how much of a region is covered by forests, wetlands, impervious surfaces, agriculture, and other land and water types. Water types include wetlands or open water.
- **Land use** not only shows how people use the landscape but also the utilization of land resources naturally. Therefore, the land of a particular region can be used for the purpose of infrastructural development, settlements, amusement & recreation, conservation of wildlife and wildlife habitat, agriculture& farming, or mixed uses and can be defined as "land use". Land use applications involve both baseline mapping and subsequent monitoring, since timely information is required to know what current quantity of land is in what type of use and to identify the land use changes from year to year.
- **Deciduous forest:** Deciduous Forest is mainly dominated by woody vegetation cover, *i.e.*, >60% along with an average plant height of more than 2 meters. The floral communities are dominated by the trees which hold broad leaves with an inimitable feature of the annual cycle of leaf-on and leaf-off periods means the trees shed their leaves at a particular season of each year, mainly in late winter.
- **Cropland:** Temporarily cropped area followed by harvest and a bare soil period (*e.g.*, single and multiple cropping systems). Different types of crop cultivation and cropping arrangement are specified according to the seasons (*e.g.*, Kharif, rabi, zaid). Cropland includes areas that are used for common crop production and are also used for the adapted crops for harvest.
- **Built-up land:** The urbanized area, *i.e.*, any land on which buildings and/or non-building structures are present, normally as part of a larger developed environment such as: a developed land lot, rural area, or urban area. The land is covered by buildings and other anthropogenic infrastructures.
- **Mixed forest:** In mixed forests, the vegetation composition principally displays the presence of trees and also includes shrubs and bushes. The mixed type of forest is neither predominated by broad-leaved trees nor by coniferous floral species.
- **Fallow land:** Fallow land is farmland without crops and usually needs a year to recover its fertility to grow crops. Such kinds of land are acquired for cultivation temporarily and are kept uncultivated for one or more seasons for its reclamation.
- **Waste land:** Sparsely vegetated land with signs of erosion and land deformation that could be attributed to lack of appropriate water and soil management, or natural causes. These are land identified as currently underutilized and could be reclaimed to productive uses with reasonable effort. Degraded forest (<10% tree cover) with signs of erosion is classified under wasteland. An empty area of land, especially in or near a city, which is not used to grow crops or built on, or used in any way and/or a place, time, or situation containing nothing positive or productive, or completely without a particular quality or activity.
- **Water body:** Areas with surface water, either impounded in the form of ponds, lakes, reservoirs, or flowing as streams, rivers, etc. Can be either fresh or salt-water bodies.
- **Plantations:** A *plantation* is a large-scale estate meant for farming that specializes in cash crops. The crops that are grown include cotton, coffee, tea, cocoa, sugar cane, sisal, oil seeds, oil palms, rubber trees, fruits, commercial horticulture plantations, orchards, and tree cash crops.
- **Wetland:** A wetland is a distinct ecosystem that is inundated by water, either permanently or seasonally. The primary factor that distinguishes wetlands from other land forms or water bodies is the characteristic vegetation of aquatic plants adapted to the unique hydric soil. Land with a permanent mixture of water and herbaceous or woody vegetation. The vegetation can be present either in salt, brackish, or fresh water.

The district administration department of Moga provided us with some information about the land use pattern of this district.

Table 8: Land use pattern of the district Moga

Class Name	Area in Sq. Km.
Deciduous forest	0.20
Cropland	From agriculture deptt.
Built-up land	From agriculture deptt.
Mixed forest	0.42
Shrub land	From agriculture deptt.
Barren land	From agriculture deptt.
Fallow land	From agriculture deptt.
Wasteland	From agriculture deptt.
Water bodies	Soil Con. Deptt.
Plantation	0.10
TOTAL	**0.72**

According to the given information by revenue dept. in 2019-20, the land utilization pattern and land use pattern of the Moga district are listed below:

Table 9: land utilization pattern and land use pattern of the Moga district

Distt. -Moga	Area in Ha.
Geographical Area	223410
Forest	2145
Barren and unculturable land	952
Land put to non-agriculture use	24788
Current fallow	1553
Net sown area	193657
Area sowed more than once	192758
Total cropped area	386415

a) Forest

The forest dept. of this district is under the jurisdiction of the Divisional Forest Officer, Firozpur. The forest area is comprised of all the areas where vegetation can be found. Apart from the block forest, this includes railway or roads side area and canal strips. The area under the forest was 32.0 sq. km. during 2009-10.

The Divisional Forest Officer of Ferozepur provides us with some details about forests.

Table 10: Forest details of the district

Sl. No.	Name of the Range	Name of the Forest	Hadbast No.	Total Area in Ha.	Detail of Khasra no.	Remarks
1	Ferozepur Range	Chak Sarkar Dona JaimalSingh wala	343	433.33	1/m to 19, 21/m to 37, 42 to 52, 56 to 60, 62 to 67, 70 to 73	No mining Zone
2	Zira Range	Dine ke	53	20.70	9,10,18 to 21,32	No mining Zone
3	Zira Range	Ghuddu wala	34	5.25	76,76/1,77	No mining Zone
4	Zira Range	Gatti Harike	367	48.26	29,33,34,40 to 45,48	No mining Zone
5	Zira Range	Boole	162	11.46	34,39,41,43 to 45,48	No mining Zone
6	Zira Range	Alipur	354	1.16	17,18,23	No mining Zone
7	Ferozepur Range	Dulchi Ke	56	18.66	1to 6	No mining Zone
8	Ferozepur Range	Bare Ke	66	49.30	1m,3m to 7m,10m to 11m	No mining Zone
9	Ferozepur Range	Wear Eastate	65/1	67.47	135,140to 142,143,145,146,148,152,153, 155 to 158,160 to 162,164to 172,176,177,179,180	No mining Zone
10	Ferozepur Range	Gatti chak Jadid	367	46.72	1 to 3, 23 to 27	No mining Zone
11	Zira Range	Machhian	133	5.23	27, 28, 31&32	No mining Zone
12	Zira Range	Roshan Shah wala	14	4.69	20,210,22,37,39	No mining Zone
13	Zira Range	Hashmat wala	26	2.33	73	No mining Zone
14	Zira Range	Dhundian	146	7.89	26,27,28,32,33	No mining Zone
15	Zira Range	Soodan	-	6.04	76/2, 77,78,79	No mining

Sl. No.	Name of the Range	Name of the Forest	Hadbast No.	Total Area in Ha.	Detail of Khasra no.	Remarks
						Zone
16	Zira Range	Behbal kalan	81	26.9	1,2,3,3m,6	No mining Zone
17	Zira Range	Shah din wala	75	43.22	2 to 14,16,18	No mining Zone
18	Zira Range	Mehmood wala	-	41.46	-	No mining Zone
19	Zira Range	Hamad wala uttar	2	5.15	58,59	No mining Zone
20	Ferozepur Range	Kamaldin Niyaji	283	4.00	12	No mining Zone
21	Ferozepur Range	Gatti Mattar	362	10.00	9,13,14,178,35,37,39,42,57	No mining Zone
22	Ferozepur Range	Dona Mattar	332	166.8	9,10,13 to 16, 28,29,31,32,50,51,53,54,70,72,75 to 76,95to 99, 129	No mining Zone
23	Ferozepur Range	Hussainiwala Gulam Hussain wala	65	24.8	29to 31, 47,48,49,50,52,53,54,56	No mining Zone

Here is another list containing data about forests and no mining zone:

Sl. No.	Name of the Range	Name of the Forest	Hadbast No.	Total Area in Ha.	Detail of Khasra no.	Remarks
1	Moga Range	Adraman Forest	223	252.4	1to14, 16 to 31,35 to38, 40, 43 to 51	No mining Zone
2	Moga Range	Droli Bhabi seed farm		10	-	No mining Zone
3	Moga Range	Bassian	258	24.2	1 to 8	No mining Zone
4	Moga Range	Gatti Kamal ke	26	83.9	1 to 6, 8 to 44	No mining Zone
5	Moga Range	Manjhli	223	20.4	1, 2, 4 to 7	No mining Zone
6	Moga Range	Bandala	230	6.4	4, 5, 10	No mining Zone
7	Moga Range	Jhuggian	219	21.4	1 to 12, 14 to 17, 50	No mining Zone
8	Moga	Mandarpur		1.6	-	No mining

Sl. No.	Name of the Range	Name of the Forest	Hadbast No.	Total Area in Ha.	Detail of Khasra no.	Remarks
	Range					Zone
9	Moga Range	ManderKalan		94.05	-	No mining Zone
10	Moga Range	Parali wala	208	73.6	-	No mining Zone
11	Moga Range	Miani	221	30.5	-	No mining Zone
12	Moga Range	Mirjapur	222	29.85	-	No mining Zone
13	Moga Range	Sanghera	205	32.2	16, 17, 50	No mining Zone
14	Moga Range	Kamaal ke	259-60	14.05	4 to 7, 12 to 14,16	No mining Zone
15	Moga Range	Pipli wala	220	79.4	-	No mining Zone
16	Moga Range	Mehruwala	217	37	-	No mining Zone
17	Moga Range	Asmilepur	216	39.6	-	No mining Zone

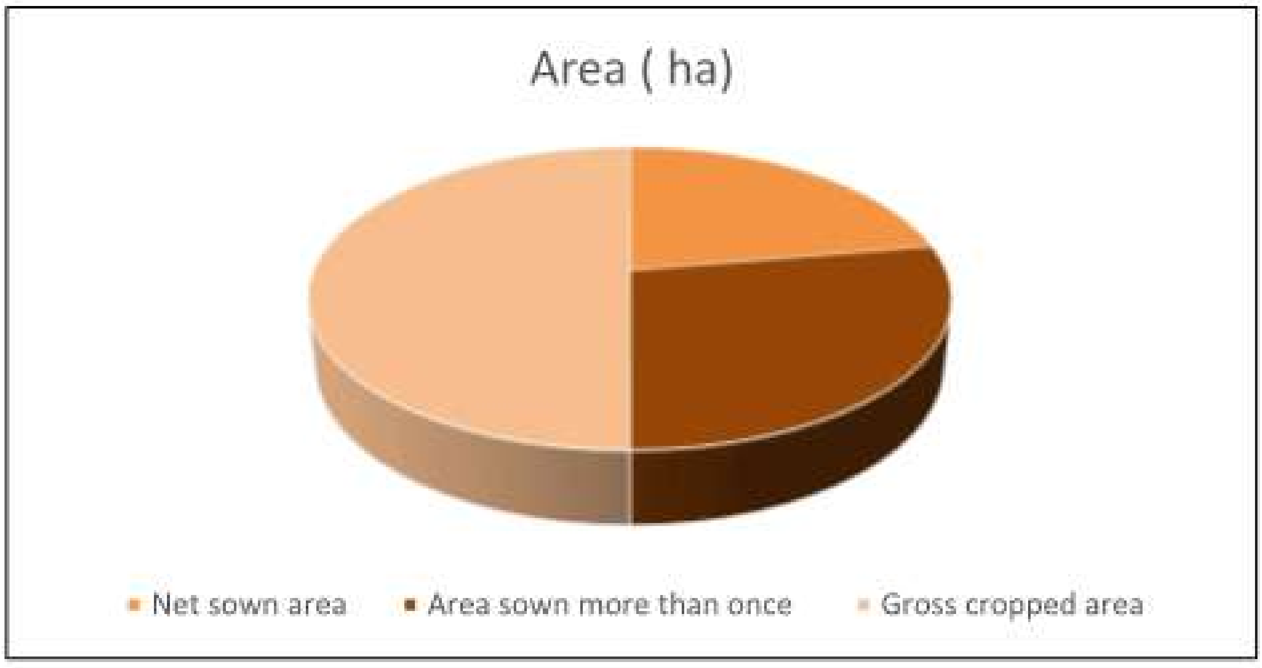
b) Agriculture and Irrigation

The main harvesting season of this district is Kharif (sawni) and Rabi (hari). The cultivation system is depending upon those seasons. During the 2008-09 area wise Rabi (195 thousand hectares) was more cultivated than Kharif (188 thousand hectares). According to production level rice (paddy) is the major Kharif crop. During 2009-2010, rice was cultivated in 1,72,000 hectares of area and production was 812 thousand metric tons. Other Kharif crops that are grown here are Maize, Groundnut, Sugarcane, Cotton, Pulses, Chillies, etc. Wheat is the major Rabi crop according to the production level during 2009-2010. That year wheat was cultivated in 1,77,000 hectares of area and production was 779 thousand metric tons. Apart from the wheat, other Rabi crops that are harvested here are Gram, Barley, Potatoes, and Oilseeds. Moga is a good place for harvesting Rapeseed and mustard also. Besides the crops, this district produces a good quantity of summer and winter vegetables and potatoes also. In the year 2011, the agricultural land use pattern was as follows:

Table 11: Agricultural land use data

Agricultural land use	Area (ha)	Cropping intensity %
Net sown area	149	224
Area sown more than once	185	
Gross cropped area	334	

Chart 5: Agricultural land use chart



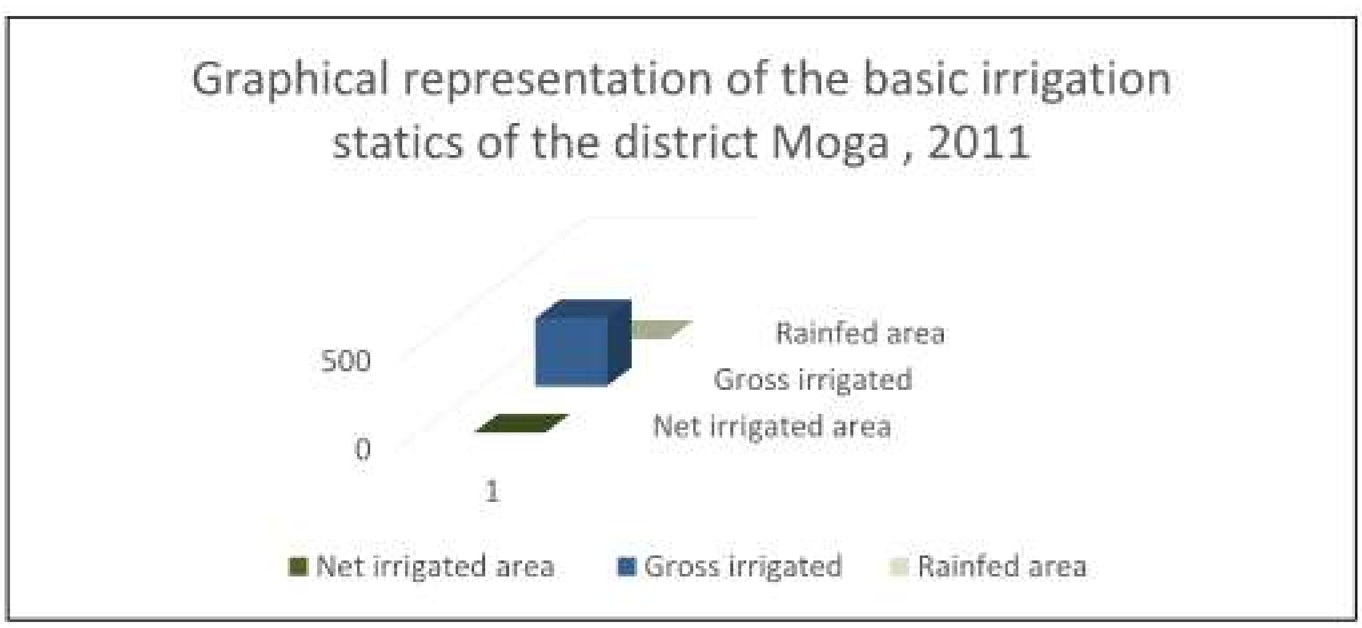
The irrigation system is very important for good harvesting and crop production. Irrigation of this district is mainly done by canals and tubewells and wells. During 2008-09, 198 thousand hectares of the area of agricultural land was irrigated by government canals and 193 thousand hectares by tubewells and wells. So, 100% of the net sown area was irrigated.

In the year 2011, the irrigation system of this district was as follows:

Table 12: Irrigation data

Irrigation	Area (Ha.)
Net irrigated area	0
Gross irrigated	383.5
Rainfed area	0

Chart 6: Graphical representation of the basic irrigation statics of the district Moga, 2011



c) Horticulture

Moga district is very rich in the production of fruits and vegetables. About 496 hectares of the area were reported under the farming of various fruit trees. The area of the cultivation land of fruits is Kinnow 155 hectares, Orange and Malta 2 hectares, Lemon 6 hectares, Guava 217 hectares, pear 1, peach 12 and plum 2 respectively, Grapes 4 hectares, Ber 70 hectares, banana 8 and others 19 hectares. The vegetables that grow here commonly are Potatoes, Onions, some winter vegetables, and some summer vegetables. The major agricultural fruit crops grown in the district are as follows:

Table 13: Horticulture Fruit crops are grown in the district of Moga

Horticulture fruit crops	Area in hectare
Kinnows	155
Guava	217
Orange and Malta	2
Peach	12
Pear	1
Lemon	6
Ber	70
Plum	2
Grapes	4

d) Mining

This district lacks any major minerals. Some minor minerals like Saltpetre, Sand, and Clay can be found here. Saltpetre is a thin yellowish layer that formed on the surface of old alluvium. It can be found in the places of Janner, Moga, and southwest of Bagha Purana. Saltpetre is a good source of potassium nitrate and is used to make crackers, matches, and fertilizers. Places around the Sukar Nala sand can be found which is normally used in building construction. A very good quality brick earth can be found near the areas of Bagha Purana, Nighalsinghwala and Moga.

6. GEOLOGY OF THE DISTRICT

- **REGIONAL GEOLOGY:** Physiographically India divides into three regions, namely Peninsular India, Extra Peninsular India and Indo-Gangetic plain. Peninsular India is mainly composed of Precambrian rocks and having Proterozoic & Phanerozoic cover while the Extra-peninsula is composed of tertiary group of rocks. The Punjab holds ground in all three divisions. A very large portions of Punjab lies within Indo-Gangetic plains, which continue south-westwards through Sind to the Arabian Sea and south-eastwards through North-West Provinces,Behar & Bengal to the Bay of Bengal. The Indo-Gangetic Plain is identified into Punjab-Rajasthan Plain, Ganga Plain, Bengal Plain and Brahmaputra Plain (Singh 1987; Singh & Ghosh 1994). The Punjab-Rajasthan Plain has been comprises Indus Plain in the west and the Punjab-Haryana Plain in the east (Singh 1996; Srivastava et.al. 2006).

  Geologically the state, Punjab, divides into two regions viz. the Siwalik foothills and the alluvial fill of Indus drainage basin. The dominant physiographic characteristics of Punjab are i) Lahore – Sargodha Ridge in the west; ii) Delhi-Jagadhari Ridge in the east; iii) Delhi-Lahore Ridge in the south and iv) Siwalik ridges in the northeast.

  Geomorphologically the State is divided into six major physiographic units –

  i) Siwalik Hills: It mainly comprises the districts – Gurdaspur, Rupnagar, S.B.S. Nagar and Hoshiarpur, covering nearly 2.6% of the total area of the state.

  ii) Piedmont Plain: Piedmont Plain area is the transition zone area between Shiwalik Hills and alluvial plains which spreads over 10 – 15 km in the districts – Gurdaspur, Hoshiarpur, S.B.S. Nagar, S.A.S. Nagar and Rupnagar. The area is characterized by gentle slopes, having an elevation ranging in between 300-375 m MSL, with undulations. Piedmont Plain mainly comprises finer sediments which is transported by seasonal rivulets.

  iii) Alluvial Plain: It occupies roughly 77% of the total geographical area of the state, spreading over Tarn Taran, Amritsar, Gurdaspur, Doaba and Malwa Plain. The plains between Beas and Sutlej rivers constitute Doaba Plains. The area included mainly Jalandhar, Kapurthala and Hoshiarpur districts. Malwa Plain mainly covers the area of the south and south-west of river Sutlej. The districts mainly fall under Malwa Plain are Fategarh Sahib, Bhatinda, Ferozepur, Faridkot, Ludhiana, Moga, Mansa, Sri Muktsar Sahib, Patiala, S.B.S. Nagar, Sangrur and Rupnagar.

  iv) Sand Dunes: It is generally found as low ridges along the courses of the old rivers and choes.

  v) Flood Plains: It covers approximately 10% of the total area of the state. The main rivers of the state – Ravi, Beas, Satluj and Ghaggar and their seasonal rivulets and choes mainly comprises the flood plain. Due to continuous erosion and deposition character of flood plain, there is no consolidation of sediments into pedogenic horizons.

  vi) Paleochannels: It occupies low-lying topographic position on the landscape and are the remnants of old active channels. In sort, these are the resultant of the continual changes in the courses of the major rivers and their tributaries, which are rendered inactive and silted over a period of time.
  The Geological Survey of India has classified the state into Newer Alluvium, Older Alluvium and Siwalik. The base configuration indicates that the Punjab basin appears to be deeper in the northern side and shallower southward and deepest being towards NW. The Neogene and Quaternary units are classified as a) **Siwalik**

Supergroup and b) the **Quaternary alluvium** comprising older alluvium and newer alluvium. Quaternary alluvium sediments lie unconformably over the Siwalik Supergroup.

a) Siwalik Supergroup: It presents an almost continuous record of Neogene terrestrial sequence with only minor hiatuses and is well known for its rich repository of vertebrate fauna along with significant invertebrate and plant fossils.It is further classified into three subgroups namely Lower Siwalik, Middle Siwalik and Upper Siwalik. The rocks of Lower and Middle Siwalik Group are exposed as NW-SE trending ridges in the northeastern part of Gurdaspur district while the Upper Siwalik rocks are exposed in Ropar, Hoshiarpur and Gurdaspur districts.

A) **Lower Siwalik Subgroup** is mainly represented by **Chinji Formation**. It is chiefly composed of fine to medium grained, sporadically pebbly sandstone and chocolate to maroon claystone. The Chinji Formation has been assigned a Middle Miocene to Upper Miocene age.

B) **Middle Siwalik Subgroup** is dominated by multistoried sandstones with occasional claystones which were deposited in flood plain environment. It is mainly comprising Nagri Formation and Dhok Pathan Formation.

- **Nagri Formation**: It overlies Chinji Formation of the Lower Siwalik Subgroup. It comprises alternating red clay and conglomerates. This formation is dated as Upper Miocene.

- **Dhok Pathan Formation**: In general, Dhok Pathan Formation is an important fossil-yielding unit of Siwalik Group, ranging in age between Upper Miocene to Lower Pliocene. The Formation is mainly consisting of poorly sorted massive, grey, coarse grained and micaceous sandstone with minor conglomerate.

C) **Upper Siwalik Subgroup** largely consists of sandstone, clay and conglomerate horizons deposited under fluviatile environment. It is divided into three formations viz. Tatrot Formation, Pinjor Formation and Boulder Conglomerate Formation.

- **Tatrot Formation**: It is the basal most unit of the Upper Siwalik that lies above the Dhok Pathan Formation and consists of conglomerates, soft sandstones and orange & brown clays. The conglomerate bed is found at the base of the formation and indicates a physical break in sedimentation after the deposition the Middle Siwalik (Krishnan, 1949)

- **Pinjor Formation**: It consist of light gery to white coarse sandstones and light pink siltstones, conglomerates and clays.

- **Boulder Conglomerate Formation**: It lies above the Pinjor Formation and is the youngest unit of the Siwalik Group. It is mainly consist of conglomerates but sandstones, siltstones and clays are also present. The sediments of this formation are coarse in nature, deposited under glacial regime & almost unfossiliferous. It ranges from Middle to Upper Pleistocene in age.

b) Quaternary Alluvium Sediments: It is sub divided into (a) Older Alluvium, (b) Newer Alluvium and (c) Aeolian Deposits.

Older Alluvium is mainly consisting of reddish clay, silt and sand with kankar, grey medium to coarse calcareous sand with kankar and subrounded to subangular unsorted pebble, gravel and cobble bed. The Newer Alluvium is composed of blue to white-grey micaceous sand with alluvium interbands of purple and red clay. The Aeolian Deposits are spread throughout the Punjab, except in the areas covered by hard rocks of Siwalik Supergroup. Based on the degree of consolidation, these can be divided into (a) stabilized and consolidated older dunes, (b) intermediate and semi-consolidated dunes and (c) newer, mobile and reversible dunes.

- **LOCAL GEOLOGY:** The district Moga is mainly represent by Recent alluvial of Quaternary age. These alluvial formations are overlain by Aeolian sands, except the area falls within Satluj River. The general geological successions encountered in the area is given below:

Table 14: Generalized Geological Succession

GROUP	GEOLOGICAL AGE	STRATIGRAPHIC UNITS	DESCRIPTION
Quaternary	Upper Pleistocene to Recent	Sand Ridges	Medium to fine grained, buff-colored dunes over the alluvium
		Newer Alluvium	Unconsolidated sand,silt,clay and gravel deposited along the Satluj in the flood plains(Active, cover and abandoned)
	Lower to Middle Pleistocene	Older Alluvium	Semi consolidated, fine to medium grained sand (grey colored) and clay (brown colored, sticky & hard) occasionally mixed with Kankar
Tertiary		Sand Stone/Shale sequences	Reddish maroon and buff-colored
Archaean		Granites / Gneisses	

7. MINERAL WEALTH OF THE DISTRICT:

The area forms a part of Indo-Gangetic alluvium. The geological formations identified in the area are: sandy clay with saltpetre encrustations at places, clay with sporadic sandy nodules, coarse sand, a water-bearing sand horizon. and impervious clay. The village, Janer, 13 km from Moga, is famous for its saltpetre production.

8. SAND AND OTHER RIVERBED MINERALS

A. SAND AND OTHER RIVERBED MINERALS

(i) Drainage System

The state, Punjab, falls under Indus Valley River System. The rivers of Indus Valley River System flow through India and then enter into Pakistan. To share the water of these rivers between the two countries, a treaty called Indus Waters Treaty was signed by India & Pakistan in 1960 at Karachi, which was brokered by World Bank. According to this treaty, the waters of three eastern rivers, i.e., Sutlej, Beas and Ravi are allocated to India and waters of three western rivers, i.e., Chenab, Jhelum and Indus are assigned to Pakistan.
The district, Moga, forms a part of Indo-Gangetic plain and Sutlaj sub-basin of Indus basin. The area as a whole is almost flat with a gentle slope towards the Western and Northwesterly direction.
The Sutlej is an important perennial river, which forms major drainage of the area and runs parallel to the Northern border of the district. The Sutlaj River enters in the district from North East side along with the boundary of Jalandhar district. It enters from the village Kania Khurd and enters the Ferozepur district from village Khana in Kot-Ise-Khan block and the total length of the Sutlej River in Moga district is 27.43 kms.
Apart from the natural drainage, the district possesses a fairly dense network of canals. The main canals in the area which feed the various distributaries, minors, sub-minors & field channels (water courses) are Sirhind feeder and Sidhwan Branch and Abohar canal which partly irrigate southern part of the district and leaves Moga to irrigate parts of Bhatinda, Muktsar and Ferozpur districts.

Table No. 15: Drainage system with description of main rivers

Sl.No.	Name of the River	Area drained (sq.km.)	% Area drained in the district
1.	Sutlaj		

Table No. 16: Salient features of important rivers and streams

SL.NO.	NAME OF THE RIVER/STREAM	TOTAL LENGTH IN THE DISTRICT(KM)	PLACE OF ORIGIN	Altitude at Origin
1.	Sutlaj			

(ii) Annual deposition of river bed minerals

Evolution based on following parameters:

a) Geomorphological studies

i) Place of Origin

- Sutlej River:

ii) Catchment area

- Sutlej River:

(iii) General profile of river/stream

River's profile can be described by two distinct profiles: long profile and cross profile. Long profile is generally defined by the change in altitude and gradient from the source to the mouth of the river. The long profile is portrayed as a smooth concave shape but in reality, there are sometimes sharp drops in gradient due to differential geology or rejuvenation. The cross- valley profile is the cross-section through the river valley at any given point along the long profile. As at the source, the river erodes vertically down towards base level, the cross- section is showing a steep-sided, narrow valley The amount of kinetic energy generated by the river is determined by the discharge, slope angle and velocity of water. In the middle and lower course, rivers are characterized by an increase in discharge and helps to erode the riverbed and banks. With the decrease in gradient associated with the lower reaches of a river comes an increase in deposition and this leads to the formation of wide floodplains and levees either side of the channel. That is why in downstream, the cross-sections form a wider, deeper valley.

The slope of the rivers, Sutlej, in this case, has been measured following the method of Digital Elevation Model (DEM). To reach the targeted approach, here contour lines are digitized from topographic map using a scale of 1:8000; from this map few contours are also digitized in flat areas. Spot heights are also digitized. From this height data, contour interpolation is completed in ArcGIS approach. This slope map is exported to ERDAS for further processing.

(iv) Annual deposition factor

Rivers are important geological agents for erosion, transportation and deposition. Deposition and erosion in river valleys can strongly modulate the downstream delivery of sediment (Fan and Cai, 2005; Malmon et al.,2005). A riverine sediment budget provides an effective conceptual framework within which to quantify sediment mobility, transport, deposition, and storage within a drain-age basin, as well as sediment output from the basin (Walling et al., 2002). It is therefore critical to understand this modulation effect (Walling and Horowitz,2005). Annual deposition of riverbed materials depends on various factors which are as follows:

Geological erosion and soil erosion are the two basic terms used to describe the erosion processes. Geological erosion refers to regular or natural erosion brought on by long-term geological processes that wear down mountains and produce floodplains, coastal plains, and other landforms to develop. Soil erosion happens gradually or at an alarming rate, but it is a continual process. It leads to various negative effects, including ongoing topsoil erosion, ecological harm, soil collapse, and many more.

The soil fragments are loosening or being washed away in the valleys, oceans, rivers, streams, or far-off regions throughout this process. Human activities like agriculture and deforestation have contributed to this situation getting worse.

Fluvial erosion is the direct removal of soil particles by moving water. The force of the flowing water and the resistance of the bank material to erosion both affect the pace of fluvial erosion.

Sediment transport is the transportation of detrital particles via air, water, ice, or gravity. When transported by air and water (fluid transport), grains (which may be sand particles) travel as a bed load (by rolling, sliding, and saltation) or in suspension when the turbulence keeps the grains moving.

The amount and size of sediment moving through a river channel are determined by three fundamental controls: competence, capacity and sediment supply.

The sediment load of a river is transported in various ways although these distinctions are to some extent arbitrary and not always very practical in the sense that not all of the components can be separated in practice:

i. Dissolved load
ii. Suspended load
iii. Intermittent suspension (saltation) load
iv. Wash load
v. Bed load

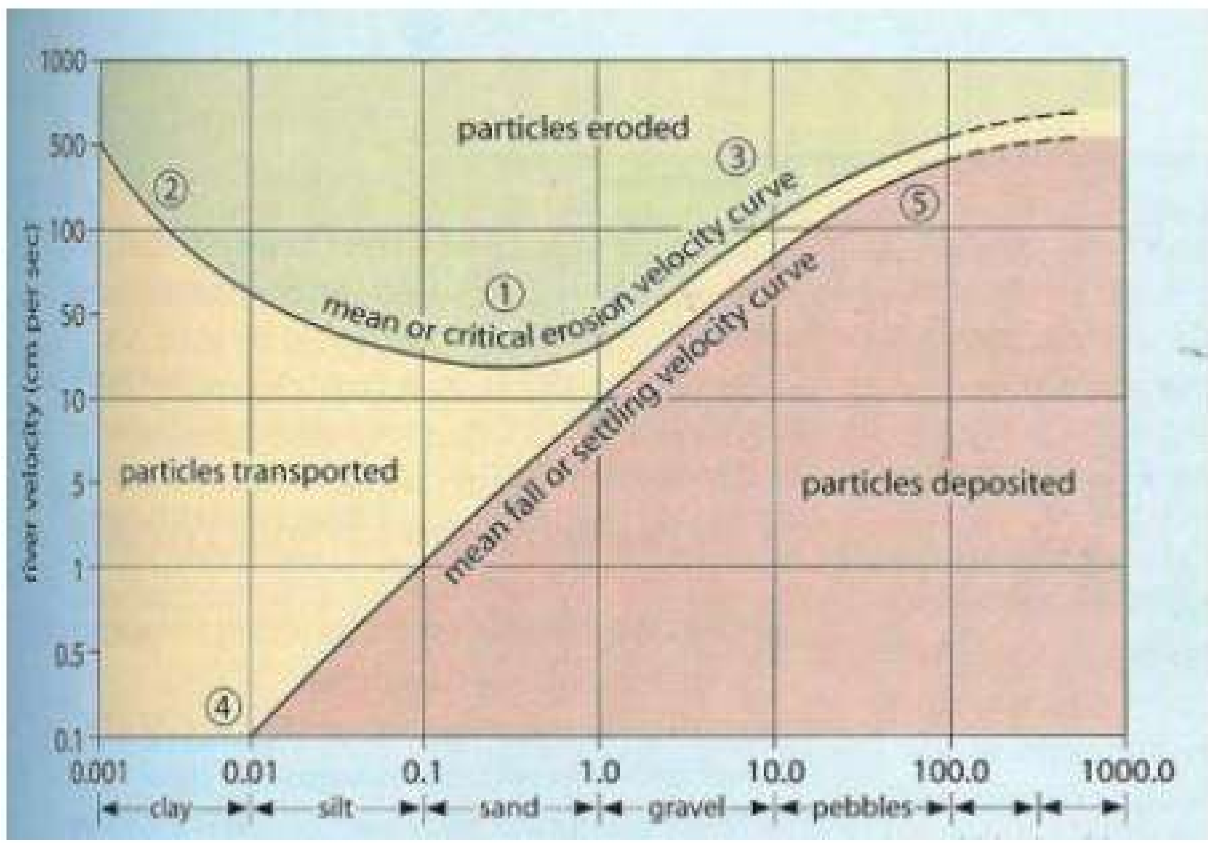
Dissolved Load: The amount of sediment carried in solution by a stream's total sediment load, particularly ions from chemical weathering, is known as the dissolved load. Along with suspended load and bed load, it makes up a significant portion of the overall amount of debris removed from a river's drainage basin.

Suspended Load: The term "suspended load" describes the portion of the total sediment transport that is kept suspended by turbulence in the flowing water for extended periods of time without contact with the stream bottom. It is nearly moving at the same speed as the flowing water.

Saltation Load: The portion of the bed load that is moving, either directly or indirectly, as a result of the impact of bouncing, i.e., intermittent jumping motion of the particles, along the stream bed.

Wash Load: Particle sizes smaller than those found in substantial amounts in the bed material make up that portion of the suspended load. It is conveyed through the stream without deposition since it is in almost permanent suspension. The discharge of the wash load through a reach is determined solely by the rate at which these particles become available in the catchment area, not by the flow's transport capacity.
Bed Load: Particles that are too large to be carried as suspended load are bumped and pushed along the stream bed as bed load. Bed load sediments do not move continuously. Streams with high velocity and steep gradients do a great deal of down cutting into the stream bed, which is primarily accomplished by movement of particles that make up the bed load.
Process of deposition: After erosion, the eroded materials get transported with running water. When the river losses its energy and velocity falls, the eroded material is being deposited. A river can lose its energy when rainfall reduces, evaporation increases, friction close to river banks and when enters a shallow area (flood plain) or towards its mouth where it meets another body of water.

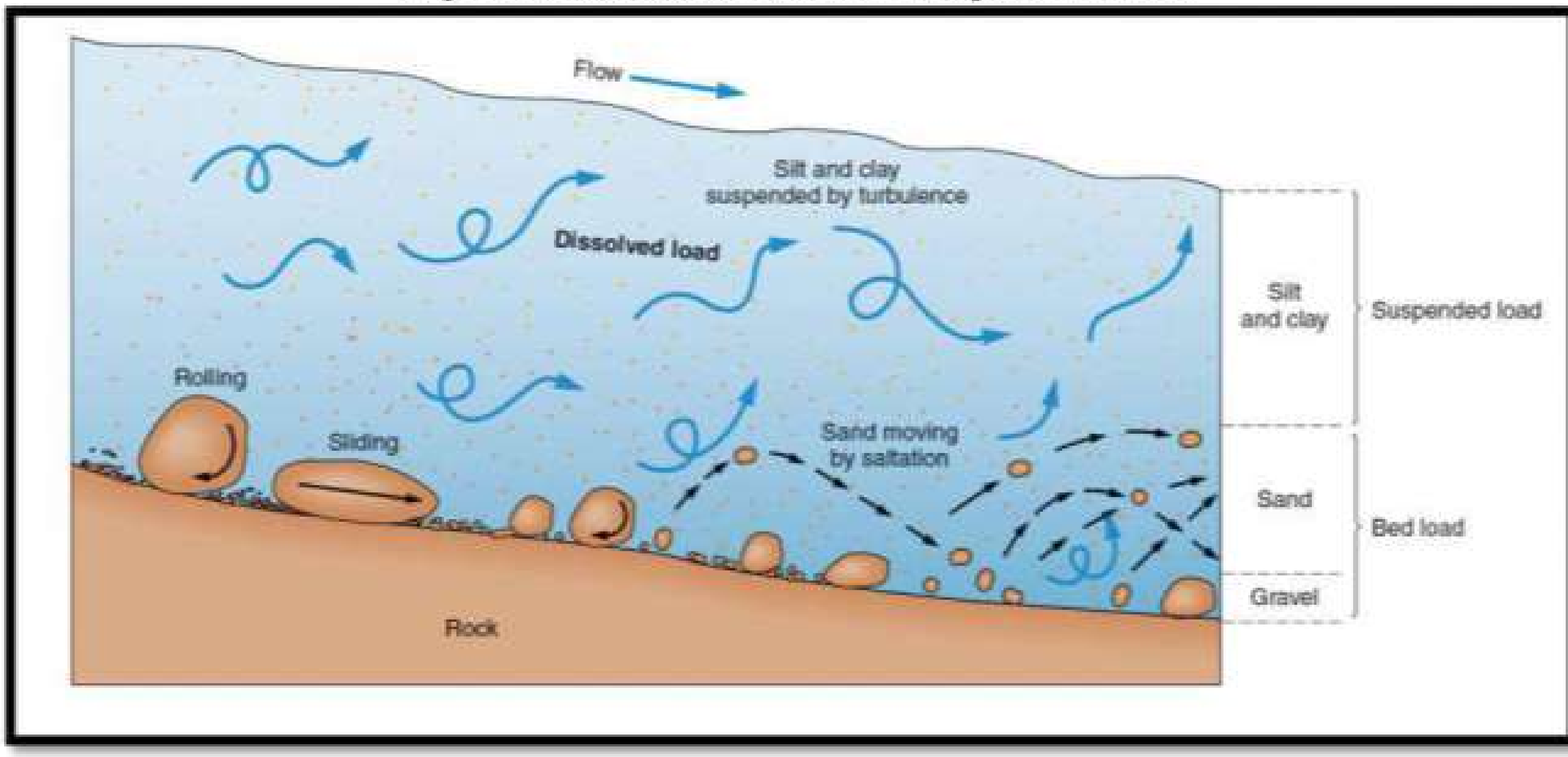
Figure 1: Hjulström curve



showing the relationship between particle size and the tendency to be eroded, transported or deposited at different current velocities.
Methodology: The catchment area of river has been analyzed with the help of Arc-GIS approach. The mined affected area of the river will be measured through Arc-GIS approach and ground-based survey by GPS approach gives fruitful results. The stretch of the mined area of river is divided in various segments, depending on stretch of the rivers. The width (meters) and GPS information at each segment is collected to quantify the total mined area of river. The geo-morphological patterns, in terms of stream orders were also observed using ArcGIS methodology. Besides, the mined affected area of the river is divided into various segments to analyze grain size distribution in river bed. The role of hydraulic gradient of most of the rivers has been scrutinized in detail to explain the causes of riverbed sand deposits. Although, the role of drainage density is of paramount importance in riverbed sand deposition.
Bed material: The mixture of sediment that composes stream bed is called bed materials. Bed material is stationary, but particle size is important to sediment transport because as energy level of a stream increases, some bed-material particles are mobilized and become part of the bed load or suspended load. In this report, composition of bed material is defined by particle-size distribution.
Suspended Sediment Material: Suspended small particles in turbulence of the flow are exist as colloids and transported at about the same downstream velocity as the flowing water. Suspended sediment was distributed at all depths in flowing water. In this report, suspended sediment is expressed as concentration in milligrams per

liter.
Suspended-sediment load: In this report, annual suspended-sediment load is expressed in tones.
Suspended-sediment discharge: A computed value of the quantity (weight) of suspended sediment per unit time also referred to as suspended-sediment transport rate.
Total sediment load: The sum of bed load and suspended sediment load, together called total sediment load. In this report, total sediment load is expressed in tonnes. Total sediment discharge is expressed as, the sum of bed load discharge and suspended-sediment discharge.

Figure 2: Modes of Sediment Transport in Rivers



When a graph is plotted with the riverbed elevation on the vertical axis and the upstream distance on the horizontal axis, a smooth curve may pass through the points. This result is called the 'Longitudinal Profile' or 'Long profile' of the river. The longitudinal profiles of most rivers are 'concave upward'. The reason is not difficult to understand. In the downstream direction when one tributary joins the river after another then each of them add discharge. As the river grows larger, the ratio of cross-sectional area to wetted perimeter increases. Because the slope of the river depends, in large part, on the relative magnitude of the down slope driving force of gravity, which is affected by the whole volume of the river, and the up slope resisting force of friction, which is affected by the area of the riverbed, the slope decreases downstream. A longitudinal profile was protracted from the upstream to downstream areas to achieve the goals of the current project. Profile points were surveyed in the 'thalweg' i.e., the line area of lower elevation within a valley or watercourse and the survey was detailed enough to illustrate the channel morphology (riffle- pool sequences).
The **base level** of a river is the elevation of the water surface of the water body, along the river course, into which the river flows. Therefore, the river has some equilibrium longitudinal profile, according to the sense of that; if conditions of precipitation, sediment supply, and base level remain constant the longitudinal profile will stay unchanged. If a different set of conditions is imposed upon the river, the river adjusts its longitudinal profile accordingly toward a new equilibrium.
If base level rises, some of the sediment will be carried out along the river toward the river mouth and will be deposited along the way to raise the river bed, thereby establishing a new equilibrium longitudinal profile. If base level falls, the river erodes its bed to adjust toward a new, lower equilibrium profile. There's more to be said, however, about what happens as the river erodes its bed as a consequence of a fall in base level. The erosion does not happen uniformly everywhere at the same time, but by upstream propagation of a point where the channel slope changes, from steeper downstream of the point to less steep upstream of the point.
The point of change in slope is called a 'knick point'. The position of a knick point is marked by a 'waterfall' or "rapids". Knick points migrate slowly towards upstream; thereby extend the new, lower longitudinal profile as

the river eats its way upstream. If a floodplain has developed in the river valley, the old floodplain downstream of the knick point survives, for a long time, as a pair of terraces above the new, lower river channel. Because the difference between old and new equilibrium profiles decreases upstream, other things being equal (the elevations of the highlands in the headwaters of the river are very conservative), the height of this knick point decreases as it migrates upstream. Often, if base level drops abruptly a number of times during some long period of time, more than one knick point is present along the river course, each slowly making its way upstream.

Sediment Transport Rate: The rate at which sediment is moved past a cross section of the flow is called either the sediment transport rate or the sediment discharge. It's related to the sediment load, but it's different, just because different fractions of the sediment load are transported at different rates. It can be measured in mass per unit time, or in weight per unit time, or in volume per unit time.

Sediment Discharge formulae: To derive a sediment discharge formula, have to think about the physics of sediment transport in a way that allows you to develop the form of some rational equation for transport rates, which contains within it one or more adjustable parametersl whose values are assigned by analysis of selected data sets already at hand. Our common sense tells us that the stronger the flow the greater the sediment transport rate. And an important first-order fact of observation is that the sediment transport rate is a very steeply increasing function of the flow strength. Think about the simplest way to embody these important facts in a formula for the sediment transport rate per unit width of flow, usually written 'qs'.

Sediment Yield: To introduce just one more thing about sediment in rivers, we should make a distinction between the sediment discharge and what's called the sediment yield of a river. The sediment yield is the sediment discharge divided by the total drainage area of the river upstream of the cross section at which the sediment discharge is measured or estimated. The sediment yield measures the rate, per unit area, at which sediment is removed from the watershed. It is important in studies of the long-term evolution of landscapes drained by rivers.

All the above-mentioned details are strongly applicable for the rivers which are perennial in nature.

(v) Replenishment

Replenishment defines rejuvenation of riverbed sand deposition phenomena. The word replenishment is the fulcrum of riverbed sedimentation under different depositional environmental conditions especially during rainy seasons.The rate of gross or absolute silt production (erosion) in the watershed and the ability of the stream system to transport the eroded material in a river have a direct relation with the quantity of sediment delivered into a river. The rate of gross erosion is dependent upon many physical factors like climatic conditions, nature of soil, slope of the area, topography and land use. Hydro-physical conditions of the watershed govern the capability of transporting the eroded material. It has been observed that the average rate of sediment production decreases as the size of drainage area increases. And also, larger the watershed, the lesser is the variation between the rates. The larger watershed presents more opportunity for deposition of silt during its traverse from the point of production. The watershed with maximum land use class of forest, generate very low rate of production unless the forests are degraded or open forest. The cultivated watersheds with unscientific farming produce very high rate of silt production. The total amount of eroded material, which reaches a particular hydraulic control point, is termed as sediment yield. The rotational mining is being adopted to facilitate the replenishment of the excavated pits during rainy season. Thus, the mineable area is to be divided in two blocks i.e., the upstream block and the downstream block. The mining of these blocks is suggested on rotation basis in such a way that pit of previous year mining will act as depository for the monsoon season. Sand is extracted from the said lot during one year; more than the extracted quantity of the same are automatically replenished by rainfall in the monsoon by the river/nallah itself on account of its flow and velocity.

For sustainability of river sand mining, it is necessary that the mine pits formed as a result of sand excavation are refilled with sand by natural process of replenishment in a reasonable period of time so that the area is again available for mining. The rate of excavation should be decided in accordance with the rate of replenishment which is the rate at which sand/gravel is deposited on the river flood plain by the river during monsoon season. However, determination of site- specific rate of replenishment is quite difficult as it is dependent on several factors such as geology and topography of the catchment area of the river, breadth of the flood plain, rainfall in that particular year (which is quite variable and not very much predictable much in advance) etc. Dandy-Bolton formula is generally used to calculate the sediment yield. But it is to be kept in mind that to prepare the mining plans of the mines, the factor of annual replenishment is to be taken into consideration while calculating the mineral reserves. It has also been observed that during flooding, all the pits replenish with sand. Hence, mined out areas in the pre- monsoon season will be completely replenished with sand during monsoon. Therefore, it has been assumed that the pits will be replenished after each monsoon.

The main river of the district is Sutlaj. The river Sutlaj originates from Darma Oass near Mansarovar Lake in Tibet. At Harike, Beas meets Sutlaj and finally enters Pakistan near Suleimanki near Fazilka District of Punjab.

Base Flow is influenced by incoming groundwater to aquifers and is closely related to watershed characteristics. Understanding baseflow characteristics is of great importance to river ecosystems and water management. Baseflow is the portion of stream flow that is delayed subsurface flow and generally maintained by groundwater discharge. Regardless of the specific climatic environment, its main features are tightly related to geological catchment properties. Understanding the baseflow process is important to deal with various water resources issues, such as water resources management strategies, low flow conditions assessment, hydrological modeling calibration, and water quality studies. However, no direct approach exists for continuously measuring the variability of streamflow recession under different conditions and the corresponding baseflow, because the baseflow is usually affected by diverse climatological and geological factors, with considerable variations in spatio-temporality. watershed characteristics (e.g., geology, land use, soil type, etc.) and climatic conditions influence baseflow discharge to streams. Addressing such processes requires quantitative estimates of baseflow discharge across a gradient of watershed types. The development of quantitative methods for baseflow estimation is also necessary to understand water budgets (Stewart et al., 2007), estimate groundwater discharge (Arnold and Allen, 1999) and associated effects on stream temperature (Hill et al., 2013), and address questions of the vulnerability and response of the water cycle to natural and human-induced change in environmental conditions, such as stream vulnerability to legacy nutrients (Tesoriero et al., 2013). Given the importance of baseflow, many methods have been used to quantify the baseflow component of stream discharge beginning with Boussinesq (1877). Approaches for baseflow estimation can be grouped into two general categories: graphical hydrograph separation (GHS) methods, which rely on stream discharge data alone, and tracer mass balance (MB) methods, which rely on chemical constituents in the stream, stream discharge, and the streamflow end-member constituent concentrations (runoff and baseflow). Many different approaches for GHS exist, including recession curve methods and digital filter methods. Recession curve methods are generally considered more objective than digital filter methods because they provide an assumed integrated signal of basin hydrologic and geologic characteristics through identification of a linear recession constant based on the falling limb of the hydrograph (Barnes, 1939; Hall, 1968; Gardner et al., 2010).

However, in the present context, in case of the rivers of Moga district, the volume of the precipitated sand has been derived during Pre-monsoon and Post-monsoon period along with the thickness of the sand layers deposited during pre-monsoon as well as post-monsoon periods. But, to erect hydrograph model which is essential for estimation of depth of base flow, data on daily discharge of water volume is required. Hence, it can be proposed that if these data are provided from the concerned authority of the state government (secondary data- already requested for providence), depth of base flow as well as the hydrograph model can be estimated. The quantative estimation of the depth of base flow cannot be done due to absence of data. But a relative comparison between the mining depth and depth of baseflow has been done on the basis of collected data by making pit on the river bed.

Replenishment study Method: There are many sediment transport equations which are suitable for use in the prediction of the replenishment rate of rivers/ watershed. Some of the famous sediment transport equations are:

1. Dandy – Bolton Equation
2. Yang Equations

3. Engelund-Hansen Equation
4. Modified Universal Soil Loss Equation (MUSLE) developed by Williams and Berndt (1977)

The most popular method is Dandy Bolton Equation. But due to wide variability caused by local factors not considered in the equation development, by applying the equation we can only get rough approximation of mean sediment yields on a regional basis for preliminary watershed planning.
On the light of above context, in this report, for understanding the amount of sediment deposition, volumetric calculation is used. And from the difference between pre-monsoon and post-monsoon sediment deposition, replenishment rate is calculated.
Initially River stretch has been demarcated through latitude & longitude by detailed satellite as well as field survey. During the field survey, on some river plain, pits have been constructed along the upstream-downstream side of the river bed. The co-ordinates of the constructed pit have been measured by GPS. The cross sections have been prepared on the basis of databases on latitude & longitude of both the extents of section line, chainage and respective levels of all the points taken on that section line. Reserves have been estimated with the help of calculated mining area, mining depth and specific gravity of sand. For each proposed sand block mining area has been derived by using google earth and ARC-GIS 10.8 Software. Mining depth (d) has been derived from the field survey.

Calculation:

The mining area (A) for each block has been calculated through Arc-GIS software.
Mining depth= Pit depth (d)
Estimation of sand reserve = Volume of the excavated sand block (V) = Area (A) * Mining depth (d)
Total reserve (in m3 or m cum) = Volume of the sand of the block (V) in m3

- **Field data collection:** Field survey for sand replenishment data have been carried out during June 2022 for pre-monsoon survey. Still post-monsoon data need to incorporated for final calculation of replenishment. However, the non-operational areas were covered through traverses. Relative elevation levels were captured through GPS. Thickness of the sandbars was measured through sectional profiles. In few instances, sieve analysis of the sands was carried out to derive the size frequency analysis.

- **Selection of study profiles:** Study profiles are selected based on the occurrence of the sand bars in the channel profiles. Aerial extents of each of the profiles are mapped from satellite imageries. Frequency distribution did while selection of the ground truthing of the blocks.

- **Data compilation:** Following data will be compiled for generation of this annual replenishment report:

  I. Elevation levels of the different sand ghats and sandbars as measured at site.
  II. Extents of the sandbars are measured from the post monsoon satellite imageries.
  III. Sand production data of the district.

- **Development of cross profiles:** Cross section lines are chosen based on the drastic variation of the river widths, proximity of the operating sand ghats and the position of the sand bars.

Table 17:

Sl. No.	River Name	Section Line	Latitude	Longitude	Block Name

Assessment of sediment load in the river: Assessment of sediment load in a river is subjective to study of the whole catchment area, weathering index of the various rock types which acts as a source of sediments in the specific river bed, rainfall data of the area for a period not less than 20 years, and finally the detail monitoring of the bed upliftment with time axis. Again, the sediment load estimation is not dependent variable of the imaginary district boundary, but it largely depends upon the aerial extents of the catchment areas, which crossed the district and state boundaries.

Table 18: Estimation of Sand Resources in Pre & Post monsoon period in Sand bars

Sl.No.	Unique Id Code	Name of the river	Area (Ha)	Sand Thickness (Meter)	Sand volume in Cum/Year	Area (Ha)	Sand Thickness (Meter)	Sand volume in Cum/Year
Pre-Monsoon						Post-Monsoon		
1	PB-MOGA-SUT-01	SUTLAJ	5.73	1.2192	69860	-	-	-
2	PB-MOGA-SUT-02	SUTLAJ	9.82	1.0668	104759	-	-	-
3	PB-MOGA-SUT-03	SUTLAJ	22.05	1.2192	268833	-	-	-
4	PB-MOGA-SUT-04	SUTLAJ	7.66	1.524	116738	-	-	-
5	PB-MOGA-SUT-05	SUTLAJ	10.18	1.6764	93086	-	-	-
6	PB-MOGA-SUT-06	SUTLAJ	11.88	1.0668	126735	-	-	-
7	PB-MOGA-SUT-07	SUTLAJ	8.6	1.524	131064	-	-	-
8	PB-MOGA_-SUT-08	SUTLAJ	6.46	1.2192	78760	-	-	-
9	PB-MOGA-SUT-09	SUTLAJ	2.16	1.6764	36210	-	-	-
10	PB-MOGA-SUT-10	SUTLAJ	2.41	1.524	36728	-	-	-
11	PB-MOGA-SUT-11	SUTLAJ	1.12	1.524	17069	-	-	-
12	PB-MOGA-SUT-12	SUTLAJ	7.35	1.6764	123215	-	-	-
13	PB-MOGA-SUT-13	SUTLAJ	10.26	1.0668	109454	-	-	-
14	PB-MOGA-SUT-14	SUTLAJ	6.70	1.0668	71476	-	-	-
15	PB-MOGA-SUT-15	SUTLAJ	1.43	1.6764	23973	-	-	-
16	PB-MOGA-SUT-16	SUTLAJ	6.0	1.524	91440	-	-	-
17	PB-MOGA-SUT-17	SUTLAJ	2.95	1.2192	35966	-	-	-
18	PB-MOGA-SUT-18	SUTLAJ	3.51	1.0668	37446	-	-	-
19	PB-MOGA-SUT-19	SUTLAJ	1.42	1.524	21641	-	-	-
20	PB-MOGA-SUT-20	SUTLAJ	9.23	1.219	112514	-	-	-
21	PB-MOGA-SUT-21	SUTLAJ	5.92	1.0667	63149	-	-	-
22	PB-MOGA-SUT-22	SUTLAJ	8.80	1.219	107272	-	-	-
23	PB-MOGA-	SUTLAJ	3.33	1.0668	35524	-	-	-

Sl.No.	Unique Id Code	Name of the river	Area (Ha)	Sand Thickness (Meter)	Sand volume in Cum/Year	Area (Ha)	Sand Thickness (Meter)	Sand volume in Cum/Year
	SUT-23							
24	PB-MOGA-SUT-24	SUTLAJ	5.11	1.0668	54513	-	-	-
25	PB-MOGA-SUT-25	SUTLAJ	24.18	1.372	331749	-	-	-
26	PB-MOGA-SUT- 26	SUTLAJ	7.11	1.372	97549			
27	PB-MOGA-SUT- 27	SUTLAJ	2.01	1.372	27577			
28	PB-MOGA-SUT- 28	SUTLAJ	2.11	1.372	28949			

Table 19: Sediment Load Comparison Pre & Post monsoon period for different rivers of Moga District
Replenishment rate will be calculated after the post monsoon survey

IV. Total potential of minor mineral in the river bed

Total potential of minor mineral for two rivers in the river bed is calculated after post monsoon survey. Generally, 3m from both the length and average width of the area is left behind. So, the total volume is calculated by multiplying the area obtained with average depth.

Total reserves of minor mineral (in Tonnage) = length X width X depth X density

Total mineable mineral reserve (in metric ton) is calculated by taking 60% of the total mineral reserve.

Total mineable mineral potential = 60% of the Total mineral potential

b) Geological studies

i) Lithology of the catchment area

Newer alluvium, friable sandstone and siltstone

ii) Tectonics and structural behavior of rocks

Punjab lies in a foredeep, a downwarp of the Himalayan foreland, of variable depth, converted into flat plains

River Name	Pre-monsoon No of Ghats	Post-monsoon No of Ghats	Pre-monsoon Sediment Load (Cum)	Post-monsoon Sediment Load (Cum)	Difference (Cum)	Percentage Variance	Remarks
Sutlaj	28	-	2453249	-	-	-	**Post monsoon survey is still pending**
Total	**28**	-	2453249	-	-	-	**Post monsoon survey is still pending**

by long-vigorous sedimentation. This is known as a geosyncline. This has shown considerable amounts of flexure and dislocation at the northern end and is bounded on the north by the Himalayan Frontal Thrust. The floor of the trough (if see without all the sediments) is not an even plain, but shows corrugated inequalities and buried ridges (shelf faults). Much of Punjab lies in the Punjab Shelf, bounded on the east by the Delhi-Haridwar Ridge and on the south by the Delhi-Lahore Ridge. Most earthquakes in this region are shallow though a few earthquakes of intermediate depth have been recorded in Punjab.

As per the 2002 Bureau of Indian Standards (BIS) map, District Moga falls under seismic zone IV. The area of Moga falls in the Sutlaj Basin which itself forms a part of the Indo - Gangetic alluvial plain. The upland plain covers a large part of the district particularly. Its elevation ranges from about 305 meters above sea level in the northeast to about 213 meters above sea level in the south-west, with a gentle gredient of about 1 meter in 1.6 km. This is the most important physiographic unit in the district.

c) Climatic factors

i) Intensity of rainfall

Rainfall is a key contributing factor to land degradation, such as soil erosion. This is a result of the ability of rainfall to dissolve, loosen or worn away soil by the force of raindrops, runoffs, and river flooding and deposit in other places (Balogun et al. 2012; World Meteorological Organization 2005). Rainfall is the primary water-driven force that causes soil erosion, and rainfall erosivity, which is proportional to raindrop kinetic energy, reflects its potential impact on soil erosion (Dai, Q., Zhu, J., Zhang, S., Zhu, S., Han, D., and Lv, G. (2020).

Rainfall erosivity aspect (R) is one of the six factors of the commonplace Universal Soil Loss Equation (Wischmeier and Smith, 1978) and revised customary Soil Loss Equation (Renard et al., 1997) that is stated hence;

$$\mathbf{A = R \times K \times L \times S \times C \times P}$$

Where A = Annual soil loss, R = Rainfall Erosivity Factor, k = Soil Erodibility Factor, S = Slope length factor, S = Steepness Factor, C = Cover Crop Management Factor, P = Conservation/Management Practices Factor.

The district falls under moderate to high erosivity due to its tropical and dry sub humid climatic condition.

ii) Climate Zone

The climate of the district can be classified as tropical and dry sub humid. The district is characterized by the dryness of the air an intensely hot summer and cold winter. The ye ar may be divided into four seasons. The cold season starts by late November and extends to the middle of March. It is followed by hot season which continues to the end of June when the south-west monsoon arrives over the district.

iii) Temperature variation

In Moga district, there are mainly two seasons i.e., summer and winter. Summer falls between the months of April to July and the winter November to March. In summer season the temperature touches 44 °C and sometimes higher. June is the hottest month and January is the coldest one.

No mining zone

A definition of a protected area was established by IUCN in 1994, which is described as

"An area of land and /or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means."

Mining has a range of environmental consequences for protected areas, whether operations are undertaken within them or nearby. The types of impact may be listed as follows:

• Direct land take and loss of vegetation cover in the mined area and other parts directly affected by associated activities such as deposition of tailings, or consequences such as subsidence;

• Pollution affects, especially on water supplies, aggravated by accidents (e.g., to tailing dams);

• Impacts due to access associated with mining (roads, railways, pipelines, power lines etc.), which permit illegal hunting, habitat fragmentation and alien invasions;

• Secondary effects of human immigration in association with real or perceived livelihood opportunities (e.g., on water supplies, illegal hunting, harvesting of vegetation, alien invasions, illegal land settlements);

• Impacts on other protected area values from noise and visual intrusion, arising from both mining and secondary activities, including transportation.

The 2020 guidelines for sand mining stress on protecting rivers and habitats of species including turtles and calls for such sensitive areas to be declared as no-mining zones. It also called for using the latest technology for surveillance of illegal mining as well as estimating minable reserves.

A United Nations Environment report has said that, led by China and India, the world is mining sand at unsustainable levels exceeding the replenishment rate and that can have far-reaching social and environmental implications. Unsustainable sand mining practices are rampant in India. Despite a set of guidelines in 2016 to curb the practice, illegal and unsustainable sand mining has continued to be common, spurring the Indian government to take another step toward enforcing rules. The environment ministry has now come out with, Enforcement & Monitoring Guidelines for Sand Mining 2020" to regulate sand mining and check illegal mining.

This comes four years after the Government's Sustainable Sand Management Guidelines 2016, which was unsuccessful in putting an end to rampant illegal sand mining across the country. The latest guidelines suggest the use of technologies like drones with night vision for surveillance of sand mining sites, steps to identify sources of sand, procedures for replenishment of sand, post environmental clearance monitoring of sand mining sites, a procedure for environmental audit of such areas and steps to control the instances of illegal mining.

Among these, the focus on monitoring of sand mines after environment clearance is considerable given that so far it has been an area where the performance of authorities, central or state, is considered very poor.

The need for the latest version of the guidelines was felt after illegal and unsustainable sand mining continued despite the 2016 guidelines and many court cases. Since 2016, the National Green Tribunal, in many of the cases, stressed on the need of regulating sand mining and passed several orders. The court in some cases even expressed concern over the death of officials who tried to stop illegal mining and noted that on the ground level, illegal mining is still going on. The guidelines are thus a result of many such orders by the NGT wherein the tribunal passed directions to control it.

The new guidelines also laid special emphasis on the protection of rivers and species from sand mining as it called for surveys for identifying the stretches with freshwater turtles or turtle nesting zones. "Similarly, stretches shall be identified for other species of significant importance to the river ecosystem. Such stretches with adequate buffer distance shall be declared as no-mining zone and no mining shall be permitted," the guidelines said.

It also called for a survey report in every district for identifying the sand bearing area but also the "mining and no mining zones" considering various environmental and social factors like the distance of the mining area from the protected area, forest, bridges, important structures and habitation. According to the Sand Mining Framework 2018 of the central Government's Ministry of Mines, in India, there is a shortage of sand in the country, similar to the situation in other developed and developing countries. It estimated that the demand of

sand in the country is around 700 million tons (in the financial year 2017) and it is increasing at the rate of 6-7 percent annually even as the quantity of natural generation of sand is static.
Due to uncertainties and inadequateness in supply, the selling rate of the material varies significantly leading to black marketing and illegal mining of the mineral. It noted that illegal and uncontrolled extraction of sand has an adverse environmental impact.

Protect the rivers from illegal sand mining

The main sources of sand in India are considered to be rivers (riverbed and flood plain), lakes and reservoirs, agricultural fields, coastal/marine sand and manufactured sand.
The guidelines spanning over 83 pages focus on identifying sand mining sources, its quantification and feasibility for mining considering various environmental factors like proximity of protected area, wetlands, creeks, forest etc. and presence of important structures, places of archaeological importance, habitation, prohibited area etc.
To protect the rivers from illegal sand mining, the guidelines said that abandoned stream channels on the floodplains should be preferred rather than active channels and their deltas and floodplains.
A kml file has been made to represent "No-mining-Zone" in the district.

Table 20: Annual deposition

Sl.No.	River or Stream	Portion of the river or stream recommended for mineral concession	Length of the area recommended for mineral concession (in kilometer)	Average width of the area recommended for mineral concession (in meter)	Area recommended for mineral concession (in square meter)	Total reserve (metric ton)	Mineable mineral potential (in metric ton) 60% of the total mineral potential
Total for the District (in metric ton)							

(iii) Riverbed Mineral Potential

Table 21: Riverbed Mineral Potential

Boulder (Cubic Meter)	Pebbles/Gravel (Cubic Meter)	Sand / White Sand (Cubic Meter)	Total Minable Mineral Potential (Cubic Meter)

IV) Riverbed Mineral Potential Zones

Table 22: Riverbed Mineral Potential Zones

Sl.No.	Unique Sand ID	River or Stream	Administrative Block	Tehsil	Village	Kh. No.	Coordinates		Area (Ha)	Depth (meter)	Elevation and R.L.	Geological Reserve (Cum)	Mineable Reserve (Cum)	Base Flow depth (Meter)	Remarks
							Latitude	Longitude							
1	PB-MOGA-SUT-01	SUTLAJ					31° 1'45.47"N 31° 1'46.91"N 31° 1'47.36"N 31° 1'49.66"N 31° 1'51.37"N 31° 1'53.06"N 31° 1'52.19"N 31° 1'52.67"N 31° 1'52.58"N 31° 1'49.33"N 31° 1'48.66"N 31° 1'46.71"N	75°17'3.44"E 75°17'3.68"E 75°17'3.98"E 75°17'4.41"E 75°17'3.66"E 75°16'59.99"E 75°17'0.01"E 75°16'56.74"E 75°16'47.34"E 75°16'51.50"E 75°16'54.72"E 75°16'59.34"E	5.73	1.2192	Elev. 216 m R.L. = (216 – 1.2192) =214.7808 m	69860	41916	Base Flow depth > 1.2192 m	
2	PB-MOGA-SUT-02	SUTLAJ					31° 2'2.82"N 31° 2'9.25"N 31° 2'11.06"N 31° 2'14.82"N 31° 2'15.71"N 31° 2'10.54"N 31° 2'10.58"N 31° 2'9.58"N 31° 2'7.97"N 31° 2'7.98"N 31° 2'5.51"N 31° 2'5.32"N 31° 2'5.45"N	75°16'24.33"E 75°16'26.20"E 75°16'24.59"E 75°16'23.03"E 75°16'19.52"E 75°16'15.54"E 75°16'6.48"E 75°16'5.99"E 75°16'9.32"E 75°16'10.00"E 75°16'15.77"E 75°16'15.72"E 75°16'16.35"E	9.82	1.0668	Elev. 216 m R.L. = (216 – 1.0668) =214.9332 m	104759	62855	Base Flow depth > 1.0668 m	
3	PB-MOGA-SUT-03	SUTLAJ					31° 2'9.35"N 31° 2'10.47"N 31° 2'14.31"N 31° 2'16.48"N 31° 2'16.56"N 31° 2'15.43"N 31° 2'13.77"N 31° 2'10.51"N 31° 2'11.02"N 31° 2'9.76"N 31° 2'10.38"N	75°16'1.24"E 75°16'1.21"E 75°15'58.52"E 75°15'55.42"E 75°15'50.79"E 75°15'49.64"E 75°15'49.54"E 75°15'46.26"E 75°15'38.36"E 75°15'31.28"E 75°15'30.75"E	22.05	1.2192	Elev. 216 m R.L. = (216 – 1.2192) =214.7808 m	268833	161300	Base Flow depth > 1.2192 m	

Sl.No.	Unique Sand ID	River or Stream	Administrative Block	Tehsil	Village	Kh. No.	Coordinates		Area (Ha)	Depth (meter)	Elevation and R.L.	Geological Reserve (Cum)	Mineable Reserve (Cum)	Base Flow depth (Meter)	Remarks
							Latitude	Longitude							
							31° 2'9.79"N 31° 2'8.50"N 31° 2'7.94"N 31° 2'7.83"N 31° 2'5.43"N 31° 2'5.71"N 31° 2'4.47"N 31° 2'4.32"N 31° 2'3.99"N 31° 2'7.14"N 31° 2'8.36"N 31° 2'9.22"N 31° 2'14.30"N 31° 2'16.44"N 31° 2'16.38"N 31° 2'15.36"N 31° 2'13.81"N 31° 2'10.39"N 31° 2'10.94"N 31° 2'9.57"N 31° 2'10.48"N 31° 2'9.85"N 31° 2'8.25"N 31° 2'7.79"N 31° 2'5.36"N 31° 2'5.84"N 31° 2'4.53"N 31° 2'3.90"N 31° 2'4.15"N 31° 2'3.89"N 31° 2'4.55"N 31° 2'6.55"N 31° 2'8.47"N	75°15'23.09"E 75°15'21.91"E 75°15'21.90"E 75°15'18.87"E 75°15'24.89"E 75°15'25.65"E 75°15'34.06"E 75°15'40.40"E 75°15'49.95"E 75°15'57.25"E 75°15'56.07"E 75°16'1.14"E 75°15'58.58"E 75°15'55.45"E 75°15'50.49"E 75°15'49.62"E 75°15'49.51"E 75°15'46.07"E 75°15'38.47"E 75°15'31.38"E 75°15'30.88"E 75°15'23.23"E 75°15'21.75"E 75°15'18.87"E 75°15'24.70"E 75°15'25.77"E 75°15'34.20"E 75°15'37.33"E 75°15'40.65"E 75°15'48.79"E 75°15'52.92"E 75°15'57.16"E 75°15'56.05"E							
4	PB-MOGA-SUT-04	SUTLAJ							7.66	1.524	Elev. 213 m R.L. = (213 – 1.524) =211.476 m	116738	70043	Base Flow depth > 1.524 m	
5	PB-MOGA-SUT-05	SUTLAJ					31° 2'2.30"N 31° 2'4.00"N 31° 2'8.21"N 31° 2'4.98"N 31° 2'4.15"N	75°14'6.07"E 75°14'2.86"E 75°14'3.42"E 75°13'56.93"E 75°13'51.31"E	10.18	1.524	Elev. 214 m R.L. = (214– 1.524) =212.476 m	93086	70043	Base Flow depth >1.524 m	

Sl.No.	Unique Sand ID	River or Stream	Administrative Block	Tehsil	Village	Kh. No.	Coordinates Latitude	Coordinates Longitude	Area (Ha)	Depth (meter)	Elevation and R.L.	Geological Reserve (Cum)	Mineable Reserve (Cum)	Base Flow depth (Meter)	Remarks
							31° 2'7.04"N	75°13'44.06"E							
							31° 2'8.26"N	75°13'42.40"E							
							31° 2'8.64"N	75°13'40.15"E							
							31° 2'7.72"N	75°13'38.86"E							
							31° 2'8.33"N	75°13'37.69"E							
							31° 2'8.52"N	75°13'34.71"E							
							31° 2'8.19"N	75°13'34.13"E							
							31° 2'7.72"N	75°13'34.39"E							
							31° 2'8.85"N	75°13'29.72"E							
							31° 2'9.85"N	75°13'25.31"E							
							31° 2'9.80"N	75°13'24.94"E							
							31° 2'8.80"N	75°13'26.34"E							
							31° 2'7.70"N	75°13'29.15"E							
							31° 2'6.53"N	75°13'32.98"E							
							31° 2'5.68"N	75°13'31.73"E							
							31° 2'5.07"N	75°13'34.43"E							
							31° 2'4.15"N	75°13'37.56"E							
							31° 2'2.89"N	75°13'41.03"E							
							31° 2'2.43"N	75°13'46.22"E							
							31° 2'2.60"N	75°13'49.50"E							
							31° 2'3.10"N	75°13'51.25"E							
							31°2'1.16"N	75°13'59.79"E							
							31° 2'1.79"N	75°14'5.00"E							
6	PB-MOGA-SUT-06	SUTLAJ					31° 2'21.94"N	75°12'54.79"E	11.88	1.0668	Elev. 214 m R.L. = (214 – 1.0668) =212.9332 m	126735	76042	Base Flow depth >1.0668 m	
							31° 2'19.79"N	75°12'58.04"E							
							31° 2'19.04"N	75°12'54.71"E							
							31° 2'18.89"N	75°12'56.36"E							
							31° 2'17.01"N	75°12'58.22"E							
							31° 2'17.64"N	75°12'59.11"E							
							31° 2'17.25"N	75°12'59.53"E							
							31° 2'17.22"N	75°13'3.28"E							
							31° 2'14.41"N	75°13'8.89"E							
							31° 2'13.98"N	75°12'48.20"E							
							31° 2'14.49"N	75°12'42.91"E							
							31° 2'17.12"N	75°12'36.41"E							
7	PB-MOGA-SUT-07	SUTLAJ					31° 2'23.60"N	75°12'21.09"E	8.6	1.524	Elev. 213 m R.L. = (213 – 1.524) =211.476 m	131064	78638	Base Flow depth >1.524 m	
							31° 2'23.12"N	75°12'20.72"E							
							31° 2'22.75"N	75°12'18.82"E							
							31° 2'20.92"N	75°12'15.43"E							
							31° 2'21.01"N	75°12'13.27"E							
							31° 2'22.44"N	75°12'10.52"E							

Sl.No.	Unique Sand ID	River or Stream	Administrative Block	Tehsil	Village	Kh. No.	Coordinates Latitude	Longitude	Area (Ha)	Depth (meter)	Elevation and R.L.	Geological Reserve (Cum)	Mineable Reserve (Cum)	Base Flow depth (Meter)	Remarks
							31° 2'25.62"N 31° 2'27.13"N 31° 2'27.36"N 31° 2'28.80"N 31° 2'32.31"N 31° 2'32.26"N 31° 2'24.81"N	75°12'3.18"E 75°12'0.61"E 75°11'58.33"E 75°11'54.26"E 75°11'49.09"E 75°11'58.76"E 75°12'13.38"E							
8	PB-MOGA-SUT-08	SUTLAJ					31° 3'9.89"N 31° 2'58.31"N 31° 2'50.55"N 31° 2'50.72"N 31° 2'52.65"N 31° 2'52.77"N 31° 2'53.67"N 31° 2'52.53"N 31° 3'2.25"N 31° 3'5.00"N 31° 3'5.02"N	75°11'11.40"E 75°11'9.60"E 75°11'12.28"E 75°11'9.56"E 75°11'7.26"E 75°11'7.64"E 75°11'7.45"E 75°11'9.32"E 75°11'2.96"E 75°11'4.33"E 75°11'6.20"E	6.46	1.2192	Elev. 213 m R.L. = (213– 1.2192) =211.7808 m	78760	47256	Base Flow depth >1.2192 m	
9	PB-MOGA-SUT-09	SUTLAJ					31° 3'17.17"N 31° 3'12.18"N 31° 3'9.07"N 31° 3'9.60"N 31° 3'13.50"N 31° 3'17.86"N	75°11'15.29"E 75°11'12.60"E 75°11'9.19"E 75°11'7.15"E 75°11'9.35"E 75°11'14.75"E	2.16	1.6764	Elev. 213 m R.L. = (213 – 1.6764) =211.3236 m	36210	21726	Base Flow depth >1.6764 m	
10	PB-MOGA-SUT-10	SUTLAJ					31° 3'42.80"N 31° 3'42.32"N 31° 3'41.43"N 31° 3'38.63"N 31° 3'38.03"N 31° 3'36.27"N 31° 3'32.29"N 31° 3'39.05"N 31° 3'39.31"N 31° 3'42.60"N	75°11'21.72"E 75°11'23.14"E 75°11'24.76"E 75°11'27.95"E 75°11'28.81"E 75°11'28.44"E 75°11'23.96"E 75°11'24.23"E 75°11'23.83"E 75°11'21.51"E	2.41	1.524	Elev. 212 m R.L. = (212 – 1.524) =210.476 m	36728	22037	Base Flow depth >1.524 m	
11	PB-MOGA-SUT-11	SUTLAJ					31° 4'3.99"N 31° 4'0.46"N 31° 4'1.83"N 31° 4'5.45"N	75°10'55.10"E 75°10'57.92"E 75°10'54.07"E 75°10'49.55"E	1.12	1.524	Elev. 211 m R.L. = (211 – 1.524) =209.476 m	17069	10241	Base Flow depth > 1.524 m	
12	PB-MOGA-SUT-12	SUTLAJ					31° 4'22.99"N 31° 4'12.16"N 31° 4'11.39"N 31° 4'6.94"N	75°10'36.45"E 75°10'42.83"E 75°10'48.23"E 75°10'54.96"E	7.35	1.6764	Elev. 211 m R.L. = (211 – 1.6764) =209.3236 m	123215	73929	Base Flow depth > 1.6764 m	

Sl.No.	Unique Sand ID	River or Stream	Administrative Block	Tehsil	Village	Kh. No.	Coordinates Latitude	Longitude	Area (Ha)	Depth (meter)	Elevation and R.L.	Geological Reserve (Cum)	Mineable Reserve (Cum)	Base Flow depth (Meter)	Remarks
							31° 4'8.96"N 31° 4'20.94"N 31° 4'21.35"N	75°10'55.50"E 75°10'40.45"E 75°10'38.75"E							
13	PB-MOGA-SUT-13	SUTLAJ					31° 4'31.21"N 31° 4'27.12"N 31° 4'19.35"N 31° 4'27.17"N 31° 4'33.52"N	75°10'0.13"E 75°10'18.27"E 75°10'34.69"E 75°10'29.67"E 75°10'6.07"E	10.26	1.0668	Elev. 212 m R.L. = (212 – 1.0668) =210.9332 m	109454	65672	Base Flow depth > 1.0668 m	
14	PB-MOGA-SUT-14	SUTLAJ					31° 4'38.60"N 31° 4'36.76"N 31° 4'33.66"N 31° 4'34.22"N	75° 9'55.99"E 75°10'7.60"E 75° 9'58.23"E 75°10'2.68"E	6.70	1.0668	Elev. 212 m R.L. = (212 – 1.0668) =210.9332 m	71476	42885	Base Flow depth > 1.0668	
15	PB-MOGA-SUT-15	SUTLAJ					31° 4'38.02"N 31° 4'36.20"N 31° 4'35.56"N 31° 4'34.88"N 31° 4'34.87"N 31° 4'35.17"N 31° 4'35.16"N 31° 4'36.79"N 31° 4'37.29"N 31° 4'37.01"N	75° 9'51.51"E 75° 9'48.56"E 75° 9'46.98"E 75° 9'45.08"E 75° 9'43.90"E 75° 9'44.13"E 75° 9'43.08"E 75° 9'39.47"E 75° 9'39.61"E 75° 9'44.71"E	1.43	1.6764	Elev. 211 m R.L. = (211 – 1.6764) =209.3236 m	23973	14383	Base Flow depth > 1.6764 m	
16	PB-MOGA-SUT-16	SUTLAJ					31° 4'39.66"N 31° 4'38.35"N 31° 4'37.75"N 31° 4'38.24"N 31° 4'41.63"N 31° 4'43.08"N 31° 4'43.31"N 31° 4'41.03"N 31° 4'40.91"N	75° 9'55.37"E 75° 9'45.81"E 75° 9'41.70"E 75° 9'37.19"E 75° 9'31.57"E 75° 9'35.95"E 75° 9'39.67"E 75° 9'48.18"E 75° 9'50.55"E	6.0	1.524	Elev. 214 m R.L. = (214 – 1.524) =212.476 m	91440	54864	Base Flow depth > 1.524 m	
17	PB-MOGA-SUT-17	SUTLAJ					31° 4'36.86"N 31° 4'36.33"N 31° 4'40.26"N 31° 4'44.01"N 31° 4'43.44"N 31° 4'41.70"N 31° 4'40.38"N	75° 9'30.85"E 75° 9'27.43"E 75° 9'18.81"E 75° 9'14.36"E 75° 9'18.87"E 75° 9'20.66"E 75° 9'24.61"E	2.95	1.2192	Elev. 211 m R.L. = (211 – 1.2192) =209.7808 m	35966	21580	Base Flow depth > 1.2192 m	
18	PB-MOGA-SUT-18	SUTLAJ					31° 4'50.82"N 31° 4'47.33"N 31° 4'46.06"N	75° 9'2.95"E 75° 9'11.21"E 75° 9'2.92"E	3.51	1.0668	Elev. 211 m R.L. = (211 – 1.0668)	37446	22,467	Base Flow depth >	

Sl.No.	Unique Sand ID	River or Stream	Administrative Block	Tehsil	Village	Kh. No.	Coordinates Latitude	Longitude	Area (Ha)	Depth (meter)	Elevation and R.L.	Geological Reserve (Cum)	Mineable Reserve (Cum)	Base Flow depth (Meter)	Remarks
							31° 4'48.85"N 31° 4'49.72"N 31° 4'49.41"N 31° 4'49.55"N	75° 8'54.97"E 75° 8'54.85"E 75° 8'56.67"E 75° 9'0.74"E			=209.9332 m			1.0668 m	
19	PB-MOGA-SUT-19	SUTLAJ					31° 4'54.56"N 31° 4'53.88"N 31° 4'53.09"N 31° 4'50.98"N 31° 4'50.03"N 31° 4'50.49"N 31° 4'52.42"N	75° 8'51.05"E 75° 8'50.51"E 75° 8'50.57"E 75° 8'53.24"E 75° 8'59.56"E 75° 9'0.60"E 75° 8'55.90"E	1.42	1.524	Elev. 211 m R.L. = (211 – 1.524) =209.476 m	21641	12985	Base Flow depth > 1.524 m	
20	PB-MOGA-SUT-20	SUTLAJ					31° 2'36.67"N 31° 2'35.80"N 31° 2'35.12"N 31° 2'36.33"N 31° 2'39.61"N 31° 2'45.87"N 31° 2'46.05"N 31° 2'42.08"N	75°11'29.08"E 75°11'28.07"E 75°11'20.35"E 75°11'16.92"E 75°11'10.00"E 75°11'7.38"E 75°11'8.57"E 75°11'20.16"E	9.23	1.219	Elev. 213 m R.L. = (213 – 1.219) =211.781 m	112514	67508	Base Flow depth > 1.219 m	
21	PB-MOGA-SUT-21	SUTLAJ					31° 2'3.64"N 31° 1'58.33"N 31° 1'58.55"N 31° 2'1.36"N 31° 2'6.00"N	75°16'38.87"E 75°16'36.48"E 75°16'29.91"E 75°16'25.32"E 75°16'27.30"E	5.92	1.0667	Elev. 216 m R.L. = (216 – 1.0667) =214.9333 m	63149	37889	Base Flow depth > 1.0667 m	
22	PB-MOGA-SUT-22	SUTLAJ					31° 2'7.44"N 31° 1'55.38"N 31° 1'54.96"N 31° 1'55.43"N 31° 1'55.02"N 31° 1'57.95"N	75°16'43.10"E 75°17'0.22"E 75°16'59.92"E 75°16'56.37"E 75°16'55.23"E 75°16'38.72"E	8.80	1.219	Elev. 217 m R.L. = (217 – 1.219) =215.781 m	107272	64363	Base Flow depth > 1.219 m	
23	PB-MOGA-SUT-23	SUTLAJ					31° 1'58.35"N 31° 1'51.95"N 31° 1'52.81"N 31° 1'54.32"N 31° 1'55.12"N 31° 1'55.80"N 31° 1'55.71"N 31° 1'55.03"N 31° 1'54.31"N 31° 1'54.07"N 31° 1'57.40"N	75°17'32.55"E 75°17'34.28"E 75°17'25.44"E 75°17'22.97"E 75°17'19.45"E 75°17'20.80"E 75°17'22.54"E 75°17'24.24"E 75°17'24.95"E 75°17'26.00"E 75°17'29.40"E	3.33	1.0668	Elev. 217 m R.L. = (217 – 1.0668) =215.9332 m	35524	21315	Base Flow depth > 1.0668 m	

Sl.No.	Unique Sand ID	River or Stream	Administrative Block	Tehsil	Village	Kh. No.	Coordinates		Area (Ha)	Depth (meter)	Elevation and R.L.	Geological Reserve (Cum)	Mineable Reserve (Cum)	Base Flow depth (Meter)	Remarks
							Latitude	Longitude							
24	PB-MOGA-SUT-24	SUTLAJ					31° 0'5.43"N 31° 0'3.73"N 31° 0'7.95"N 31° 0'8.47"N 31° 0'11.23"N 31° 0'13.50"N 31° 0'11.86"N	75°20'11.93"E 75°20'6.93"E 75°19'59.46"E 75°19'58.01"E 75°19'56.79"E 75°19'55.27"E 75°20'1.64"E	5.11	1.0668	Elev. 220 m R.L. = (220 – 1.0668) =218.9332 m	54513	32708	Base Flow depth > 1.0668 m	
25	PB-MOGA-SUT-25	SUTLAJ					30°59'37.94"N 30°59'30.68"N 30°59'29.14"N 30°59'29.66"N 30°59'39.03"N 30°59'40.85"N 30°59'49.50"N 30°59'48.11"N 30°59'38.84"N	75°21'2.04"E 75°21'12.40"E 75°21'5.99"E 75°20'55.95"E 75°20'41.76"E 75°20'38.76"E 75°20'36.09"E 75°20'45.54"E 75°20'57.76"E	24.18	1.372	Elev. 220 m R.L. = (220 – 1.372) =218.628 m	331749	199050	Base Flow depth > 1.372 m	
26	PB-MOGA-SUT- 26	SUTLAJ					31° 5'11.44"N 31° 5'20.04"N 31° 5'27.02"N 31° 5'34.02"N 31° 5'36.67"N 31° 5'33.43"N 31° 5'36.67"N 31° 5'34.05"N 31° 5'27.15"N 31° 5'21.79"N	75° 8'38.74"E 75° 8'40.29"E 75° 8'41.05"E 75° 8'36.45"E 75° 8'32.08"E 75° 8'33.45"E 75° 8'32.04"E 75° 8'36.47"E 75° 8'41.02"E 75° 8'41.06"E	7.11	1.372	Elev. 211 m R.L. = (211 – 1.372) = 209.628 m	97549	58529	Base Flow depth > 1.372 m	
27	PB-MOGA-SUT- 27	SUTLAJ					31° 5'43.17"N 31° 5'48.16"N 31° 5'50.11"N 31° 5'52.25"N 31° 5'52.71"N 31° 5'52.10"N 31° 5'50.61"N 31° 5'48.97"N	75° 8'22.35"E 75° 8'19.32"E 75° 8'17.35"E 75° 8'13.56"E 75° 8'10.97"E 75° 8'11.56"E 75° 8'14.15"E 75° 8'14.40"E	2.01	1.372	Elev. 211 m R.L. = (211 - 1.372) = 209.628 m	27577	16546	Base Flow depth > 1.372 m	
28	PB-MOGA-SUT- 28	SUTLAJ					31° 6'0.46"N 31° 5'58.10"N 31° 5'57.40"N 31° 5'54.54"N 31° 5'55.95"N 31° 5'58.77"N	75° 8'6.16"E 75° 8'9.69"E 75° 8'11.97"E 75° 8'14.79"E 75° 8'8.27"E 75° 8'3.88"E	2.11	1.372	Elev. 211 m R.L. = (211 - 1.372) = 209.628 m	28949	17369	Base Flow depth > 1.372 m	

(B) In-situ Minerals

Table 23: Details of in-situ Minerals

Sl. No.	Name of the mineral	Name of associated minerals, if any	Host rock of mineralization	Area of mineralized zone	Depth of mineralization	Whether virgin or partially excavated	Nature of land (whether free for mining/forest/agriculture)	Mineral reserve (approximate) mentioning grade	Location of potential mineralized zones					Infrastructure available near the mineralized zone
									Administrative Block	Village	Tehsil	Kh. No.	Coordinates	
NOT APPLICABLE														

9. OVERVIEW OF MINING ACTIVITY IN THE DISTRICT

General overview

The National Mineral Policy, 1993 facilitated the growth of mineral-based industries through investment in the private sector. As per the policy, processing units that desire to develop captive mines to secure assured supplies of raw material are allowed foreign equity participation in the manner and to the extent applicable to such processing units.

The extraction of sand and gravel from river and stream terraces, floodplains, and channels commonly attracts attention because in some situations excavation of sand and gravel may conflict with other resources such as fisheries, esthetic and recreational functions, or with the need for stable river channels. On one hand, it is possible to excavate sand and gravel from sources located in or near river or stream channels within acceptable environmental limits provided that proper safeguards and practices are utilized. On the other hand, the development of sand and gravel from sources located in or near river or stream channels may create far-reaching environmental impacts if proper safeguards and practices are not followed.

River bed mining or sand mining adjacent to a river or stream has a direct impact on the physical characteristics of the stream such as channel geometry, bed elevation, substratum composition and stability, in-stream roughness of the bed, pro velocity, discharge capacity, sediment transport capacity, turbidity, temperature, etc.

In the case of the Moga district, there is one river, Sutlej, which mainly contains alluvial deposits of the Quaternary age comprising sand, silt, clay, and kankar.

De-Siltation: Erosion and Siltation are natural phenomena. It depends upon various factors like rainfall, physiographic and geologic conditions of the basin, steep terrain slopes, deforestation/watershed degradation, various structural interventions, impoundment of water in reservoirs, etc.

Siltation leads to a reduction in the carrying capacity of the river channels as well as of the reservoirs and results in floods and loss of created useful storage. So, there is a need to build up a "National Silt Management Policy". But there are no explicit Guidelines for de-siltation or silt management in rivers in India. However, there are Guidelines and notifications regulating "Sand Mining" by the Ministry of Environment, Forest and Climate Change (MoEF&CC). Geological Survey of India (GSI) has also framed Guidelines as a model document on the "Impact and Methodology of Systematic and Scientific Mining in the river bed material" for sustainable riverbed mining.

De-silting and dredging are two different parts. Removing fine silt and sediment from river channels in order to restore the channel capacity is called de-siltation. But de-siltation does not involve widening or deepening the river channel while dredging involves the river channel enlarging through deepening and widening.

De-siltation methods are as follows:

- **Bar scalping or skimming:** It is the extraction of sand and gravel from the surface of bars. This method generally requires that surface irregularities be smoothed out and that the extracted material be limited to what could be taken above an imaginary line sloping upwards and away from the water from a specified level above the river's water surface at the time of extraction (typically 0.3 – 0.6 m).

- **Dry-Pit Channel Excavation:** These are pits excavated within the active channel on dry intermittent or ephemeral stream beds. Dry pits are often left with abrupt upstream margins, from which head cuts are likely to propagate upstream.

- **Wet-Pit Channel Excavation:** It involves the excavation of a pit in the active channel below the surface water in a perennial stream or below the alluvial groundwater table.

- **Bar Excavation:** These are pits excavated at the downstream end of the bar as a source of aggregate and as a site to trap sand and gravel. Upon completion, the pit may be connected to the channel at its downstream end to provide a side channel habitat.

• **Channel-wide River bed Excavation:** These are across the entire active channel of rivers during the dry season. The river bed is evened out and uniformly lowered.

Agriculture Sand Mining: In the early days, sand mining was confined mainly to river beds. As the demand for sand increased, sand mining started in agricultural fields too. This practice is prevalent in Haryana, where the top layer of soil varying between 1 and 2 meters is removed and stacked separately and thereafter the sand deposit which may be 10–15-meter deep is mined. After removing the sand layer up to a maximum depth of 09 meters, the top soil stacked is spread out on the field and the same is brought under the cultivation. Though the level of this land (mined out area) is lowered to the depth of the excavation and in the initial years of cultivation the productivity is low, but the productivity of the fields improves with continued cultivation and the addition of organic manure in the field.

The following recommendations should be kept in mind for mining in such leases:

1. Mining of sand in such mine leases will require environmental clearance.
2. The lease should be for sand mining either from agricultural fields or rivers. In the same lease, both types of areas should not be included.
3. Mining Plan for the mining lease (non-government) on agricultural fields/Patta land shall only be approved if there is a possibility of replenishment of the mineral or when there is no riverbed mining possibility within 5 km of the Patta land/Khatedari land. For government projects mining should be done by the Government agency and materials should not be used for sale in the open market.
4. The slope of the mining area adjacent to agricultural fields should be proper (preferably 45-60 degrees) and an adequate gap (minimum 10 feet) be left from the adjacent agricultural field to avoid erosion and scouring.

(a) List of existing mining leases of the district with location, area, and period for each minor mineral

Table No. 24: List of existing mining leases of the district with location, area, and period for each minor mineral

Sl. No.	River Or Stream	Location Of Existing Mines					Area in Hectares	Depth in Meter	Geological Reserve (mcum)	Mineable Reserve (mcum)	Status
		Administrative Block	Mouza	Kh. No.	Coordinates						
					Latitude	Longitude					
NOT APPLICABLE											

(b) List of De-siltation location (Lake, Pond, Dams, River)

Table No. 25: List of De-siltation location (Lake, Pond, Dams, River)

Name of Reservoir/Dams	Maintain/Controlled by Sate Govt./PSU etc.	Location	District	Tehsil	Village	Size (Ha)	Quantity (MT/Year)	Existing/Proposed
Not Applicable								

(c) List of Patta Lands / Khatedari land (Proposed)

Table No. 26: List of Patta Lands / Khatedari land (Proposed)

Sl. No.	Owner	Sy. No.	Area (Ha)	District	Tehsil	Village	Agriculture Land (Yes / No)
1	Sukhwinder Singh S/O Gurcharan Singh S/O Pritam Singh	-	1.1	Moga	Dharamkot	Daulewala	Yes
2	Amandeep Singh S/O Nishan Singh S/O Mahinder Singh	-	7.7	Moga	Dharamkot	Bajeke	Yes
3	Harnek Singh S/O Darshan Singh S/O Shingara Singh	-	1.7	Moga	Dharamkot	Bajeke	Yes
4	Judge Singh S/O Gian Singh S/O Tariok Singh	-	2.02	Moga	Dharamkot	Bajeke	Yes
5	Gurjit Singh S/O Balveer Singh, Gurpreet Singh S/O Balbir Singh, Balvir Singh S/O/Jagat Singh and Satnam Singh S/O Nishan Singh	-	5.1	Moga	Dharamkot	Talwandi nau Bahar	Yes

(d) M-Sand plants with location

Table No. 27: M-Sand plants with location

Plant Name	Owner	District	Tehsil	Village	Geolocation	Quantity (Tonnes/Annum)	Existing/Proposed
Not Applicable							

(e) Cluster details

Table No. 28: Cluster details

River Name	Cluster No.	Lease No.	Location (Riverbed/Patta Land)	Village	Area (in Ha)	Total Excavation (Ton)	Total Mineral Excavation (Ton)
Not Applicable							

(f) Contiguous Cluster details

Table No. 29: Contiguous Cluster details

River Name	Contiguous Cluster No.	Cluster No.	Number of leases in the cluster	Location (Riverbed/Patta Land)	Distance between clusters	Village	Area of Cluster (Ha)	Total Mineral Excavation (Ton)
Not Applicable								

(g) Transportation Routes for individual leases details

Table No. 30: Transportation Routes for individual leases details

Lease No.	Transportation Route No.	Number of tippers /days of lease	Number of tippers /days of all the lease on route	Length of the Route in Km	Type of Road (black Topped/ unpaved)	Recommendation for road (Black Topped/ unpaved)	The road will be constructed by Govt. / Lease Owner	Route Map & Location
Not Applicable								

(h) Transportation Routes for leases in Cluster details

Table No. 31: Transportation Routes for leases in Cluster details

Cluster No.	Transportation Route No.	Number of tippers / days of cluster	Number of tippers / days of all the clusters on route	Length of Route in km	Type of Road (Black Topped / unpaved)	Recommendation for road (Black Topped / unpaved)	The road will be Constructed by Govt. / Lease Owner	Route Map & Location
Not Applicable								

(i) Detail of production of sand and other minerals during last three years

Table No 32: Detail of production of sand and other minerals during last three years

Name of the mineral	For the year 2019-2020	For the year 2020-2021	For the year 2021-2022
SAND	Not Applicable	Not Applicable	Not Applicable
OTHER MINERALS	Not Applicable	Not Applicable	Not Applicable

10. DETAILS OF REVENUE GENERATED FROM MINERAL SECTOR DURING LAST THREE YEARS

Table No. 33: Details of Royalty or Revenue generated from SAND and other minerals sector during last three years

Financial Year	Royalty (Rs.)	Cess (Rs.)	Total Revenue	Production (in cft)
2019-2020	NA	NA	NA	NA
2020-2021	NA	NA	NA	NA
2021-2022	NA	NA	NA	NA

11. TRANSPORT (RAILWAY, ROAD, AIR)

Moga is well connected by Air, Rail, and Road network with other parts of the country. District Headquarters Moga is well connected by road. Bhagha Purana, and Moga are the Cities in this district having road connectivity to major towns and remote villages. Moga is about 177 KM by road to Chandigarh. The nearest Airports are Mohali about 159 kilometers and Chandigarh about 169 kilometers. There are the local buses operated by the Government and private carriers which play across the city and district. Moga is connected by rail having a railway station called Moga under Northern Railway. It is well connected with Firozpur, Ludhiana, Chandigarh, Ambala, New Delhi, and Jaipur.

12. REMEDIAL MEASURES TO MITIGATE THE IMPACT OF MINING

a) Environmental Sensitivity and Impact of Mining

The second most exploited natural resource on earth after water is river bed material. River sand is preferred for construction due to its quality. But the unscientific way of mining from the river bed leads to alter river channel morphology, physical habitats, and food webs. It also increases the velocity of flow in the river which destroys the flow regime and eventually erodes the river banks. Removal of vegetation and destruction of soil profile destroys habitat above and below the ground and faunal population decrease.

Sand aquifers help in recharging the water table and sand mining causes the sinking of water tables in the nearby areas.

b) Remedial measures

❖ **Sustainable Mining Practices:**

i. Without Environmental Clearance, no commercial sand mining is permissible on the basis of the approved DSR/Mining Plan by the concerned authority.
ii. The depth of mining in the riverbed is always less than the base flow depth or 3 meters, whichever is less.
iii. Mining shall be done in layers to avoid the ponding effect in the mining site.
iv. Haphazard extraction is to be strictly avoided.
v. No mining should be carried out in the designated "No-Mining Zone"/ "Eco Sensitive Zone" / "Restricted Zone".
vi. Annual replenishment studies, where ever applicable, must be carried out for the river.
vii. Stream / any water channel should not be diverted/blocked for the purpose of sand mining.
viii. IT tools as prescribed in the Sustainable Sand Mining Guideline, 2016, and Enforcement & Monitoring Guidelines for Sand Mining, 2020, should be utilized for monitoring the operational mining block.
ix. Restricted sand mining operation has to be carried out for mitigation of noise during the mining operation.
x. Transportation of minerals shall be carried out through covered trucks only.
xi. Mining site has to be maintained in clean and hygienic conditions at all times.
xii. During the rainy season mining practices should be stopped.
xiii. All mines/quarries are to be properly reclaimed before the final closure of the mine.
xiv. During mining operations green belt development through plantation is most important for environment safeguard, which should be under the supervision of the mining department. Different types of species should be planted near lease periphery to keep the environment clean during the post-mining period through reclamation. Where specific usefulness of land could be decided, a forestation normally planned through the site could have been considered for better possibilities of land use.
xv. There is no very high risk and hazard identification is carried out for undesirable events that can lead. During sand mining operation, risk factors, viz. accidents during loading and transportation, inundation/flooding, and quicksand conditions, should be minimized. The mining operation is mostly done manually and/or semi-mechanized way.
xvi. All mining operations will be carried out under the supervision of an experienced and qualified Mines Manager having a Certificate of Competency to manage the mines granted by DGMS. The mining site will be supplied with first aid facilities and all the workers will have unrestricted access to these facilities.

13. PUBLIC CONSULTATIONS

"Public Consultation" is very important in the policy development process. It is a regulatory process by which the public's (Stakeholder's) input on matters affecting them is sought. Accordingly, public consultation should encourage stakeholder ownership and buy-in to the policy development process by seeking assistance with data and information collection, analyses, and the identification of other persons, businesses, institutes, and other organizations that may have valuable data or information.

Procedure of Public Consultation:

The Comments of the various stakeholders may be sought on the list of mining leases to be auctioned. The State Government shall give an advertisement in the local and national newspapers for seeking comments from the general public on the list of mining leases included in the DSR. The DSR should be placed in the public domain for at least one month from the date of publication of the advertisement for obtaining comments from the general public. The comments so received shall be placed before the sub-divisional committee for active consideration. The final list of sand mining areas after the public hearing needs to be defined in the final DSR in the format as per **Annexure-V.**

14. SUMMARY

Sand mining (used here as a generic term that includes mining of any riverine aggregates regardless of particle size) is a global activity that is receiving increasing media attention due to perceived negative environmental and social impacts. As calls grow for stronger regulation of mining, there is a need to understand the scientific evidence to support effective management. This paper summarizes the results of a structured literature review addressing the question, the review found that most investigations have focused on temperate rivers where sand mining occurred historically but has now ceased. Channel incision was the most common physical impact identified; other physical responses, including habitat disturbance, alteration of riparian zones, and changes to downstream sediment transport, were highly variable and dependent on river characteristics. Ecosystem attributes affected included macro invertebrate drift, fish movements, species abundance and community structures, and food web dynamics. Studies often inferred impacts on populations, but supporting data were scarce. Limited evidence suggests that rivers can sustain extraction if volumes are within the natural sediment load variability. Significantly, the countries and rivers for which there is science-based evidence related to sand mining are not those where extensive sand mining is currently reported. The lack of scientific and systematic studies of sand mining in these countries prevents accurate quantification of mined volumes or the type, extent, and magnitude of any impacts. Additional research into how sand mining is affecting ecosystem services, impacting biodiversity and particularly threatened species, and how mining impacts interact with other activities or threats is urgently required.

The rapid rise in urbanization and construction of large-scale infrastructure projects are driving increasing demands for construction materials globally. United Nations Environment Programme (UNEP; 2014) estimated that between 32 and 50 billion tonnes of sand and gravel are extracted globally each year with demand increasing, especially in developing countries (Schandl et al., 2016).

Rivers are a major source of sand and gravel for numerous reasons: cities tend to be located near rivers so transport costs are low; river energy grinds rocks into gravels and sands, thus eliminating the cost of mining, grinding, and sorting rocks; and the material produced by rivers tends to consist of resilient minerals of angular shape that are preferred for construction (whereas wind-blown deposits in deserts are rounder and less suitable). Here, we use "sand mining" as a generic term to embrace the extraction of riverine aggregates regardless of particle size. Sand mining activities are one of many recognized pressures affecting riverine ecosystems, where biodiversity is already in rapid decline (World Wildlife Fund, 2018). Increasingly, there are media reports about the negative environmental and social impacts of sand mining, and as calls grow for stronger regulation of mining (Schandl et al., 2016), there is a need to understand the scientific evidence of mining impacts to underpin management.

The impacts of sand mining on rivers may be direct or indirect. Direct impacts are those in which the extraction of material is directly responsible for the ecosystem impact, such as due to the removal of flood plains habitat. Indirect impacts are related to ecosystem changes that are propagated through the system due to physical changes in the river system resulting from sand extraction. For example, the removal of material from a river can alter the channel, river hydraulics, or sediment budget which in turn can alter the distribution of habitats and ecosystem functioning. These types of impacts can be difficult to attribute to sand mining, as they may require long time frames to emerge, and other interventions can result in similar changes. The situation is further complicated by the existence of geomorphic thresholds in river systems (Schumm, 1979). Alterations linked to the removal of sand from rivers may not be gradual and/or linear, and only limited changes may be observed for an extended period, but once a threshold is reached, change may become rapid and irreversible. Whether the impacts of sand mining are positive, neutral, or negative depends on the situation and perceptions of different stakeholders.

During the preparation of the present report, prominent rivers/ streams have been studied in detail. It is suggested that the auctions of quarries be done regularly to meet out the local demand subject to the approval from the joint Inspection Committee as per Punjab Minor Mineral Rules 2013.These mineral concessions shall also reduce demand load and will be helpful to minimize illegal extraction of minerals, failure of which may result in to illegal mining at odd hours and shall be haphazard and more detrimental to the local ecology. Irrespective of it following geo-scientific considerations are also suggested to be taken into account during the river bed mining in a particular area:

1. Abandoned stream channels or terrace and inactive floodplains may be preferred rather than active channels and their deltas and floodplains.
2. Stream should not be diverted to form inactive channel.
3. Mining below subterranean water level should be avoided as a safeguard against environmental contamination and over exploitation of resources.
4. Mining area should be demarcated on the ground with Pucca pillars so as to avoid illegal unscientific mining.

Further, to assess the minor mineral resources other than sand a thorough and detailed exploration should be carried out. Regarding, sand mining a proper replenishment study pertaining to pre- monsoon and post monsoon data is certainly on the cards.

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