

Significance of Iron Ore Production from Pur-Banera Belt of Bhilwara District and its Contribution in Rajasthan State

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Abstract

In the Rajasthan State, iron-ore deposits are found in the district of Jaipur, Udaipur, Jhunjhunu, Sikar, Bhilwara, Alwar, Bharatpur, Dausa, and Banswara. As compared to all districts, Bhilwara is a leading producer of the iron ore deposit.

According to the Department of Mines and Geology, in the year 2017-18, iron ore in Rajasthan covers 2240.10 hectares area in which eighteen mines were engaging in the exploitation of iron ore. The total production of iron ore is 34.67 lac tonnes, of which the sale value is Rs. 1020.74 crore, and due to that, it generates total revenue of Rs. 1940.42 Lac, and this contribution lead to employing 833 employees.

In the year 2015, the total reserve/resources of iron ore (hematite and magnetite) in the state of Rajasthan is 655.31 million tonnes.

Iron ore in Bhilwara district covers the 1989.28 hectares area in which two mines are engaging in the manufacture of iron ore. The total production of iron ore is 32.04 Lac tonnes, of which the sale value is Rs. 1009.29 crore, and due to that, it generates total revenue of Rs. 1835.93 Lac, and this contribution lead to employing 801 employees. The total reserve/resources of iron ore in the district are 522 million tonnes.

In this paper, the authors discuss the statistical data of iron ore in the Bhilwara district, Rajasthan. Moreover, there is also a tremendous role of iron ore in financial as well as in employment generation in Rajasthan.

Keywords - Pur-Banera Belt, Iron Ore, Occurrence, Reserve/Resources, Production, Sale Value, Revenue, and Employment.

I. INTRODUCTION

In Rajasthan, the district Bhilwara is located nearly within the middle part of the state. It covers an area of around 10,455 sq. km. Latitude and Longitude coordinates are 25°01' to 25°58' and 74°01' to 75°28' respectively. Bhilwara is encompassed by Ajmer district in the north, Bundi district in the east, Chittaurgarh district in the south, and Rajsamand district in the west.

Twelve tehsils are present within the Bhilwara district. The names of these tehsils are Bhilwara, Banera, Mandalgarh, Mandal, Kotri, Shahpura, Beejoliya, Jahazpura, Asind, Hurda, Raipur, and Sahara. The sex (gender) proportion of Bhilwara district is more than the state Rajasthan, i.e., sex (female to male) proportion in Rajasthan state is 928, whereas in Bhilwara district it is 973 (where male were 1000).

There is nothing wrong with saying that Bhilwara district is also very famous for textiles because a great number of textile industries are present with more than 850 manufacturing units in the

vicinity of Bhilwara town. Synthetic Fabric is the main product form, which uses to make trousers.

Interestingly, in India, the only district where insulation bricks are produced in the Bhilwara district. In this area, there are around 33 units of it. In the mining sector, the Bhilwara district is quite rich with extensive mining of soapstone, feldspar, sandstone, quartz, china clay, mica, granite, etc. In which mica mining played an imperative part in the advancement of the financial and social conditions of Bhilwara district.

In recent times the most critical improvement in Bhilwara district is the acknowledgments of the area as a major metallic mineral hub, i.e., iron ore, lead & zinc producing hub. At village Agucha, Hindustan Zinc Ltd. owned and claimed its presence for mining.

In village Agucha, there is the presence of Asia's biggest deposit of zinc, lead, and silver metals. The district also contains colossal deposits of low-grade sponge iron ore, which are essentially disregarded by the industry mammoths so distant.

The potential is recognized by the M/S Jindal Saw Ltd. of Bhilwara district, and getting directions from the "Geological Survey of India" developed a tremendous iron ore mining and beneficiation plant in the district. Presently the district has gotten to be a magnet for all major steel companies of the nation. It has put the state of Rajasthan on the outline of steel businesses.

According to the Department of Mines and Geology Rajasthan, in the year 2017-18, the total iron ore production in Rajasthan was 34.67 lac tonnes, of which 32.04 Lac tonnes iron ore was produced by Bhilwara district.

Different from the above, the Steel Authority of India Limited decides to contribute approx. Rs. 800 crore to develop Bhilwara district as an iron ore mine in Rajasthan as well as they plan to manufacture 5 million tonnes per annum iron ore and also set up a 2 million tonnes per annum capacity pellet plant in the district.

The Rashtriya Ispat Nigam Limited plans to at first contribute Rs.2,500 crore to develop a unit for beneficiation and a pellet plant of 2 million tonnes in Bhilwara district for esteem expansion of the ore before going to use it at the Vizag Steel Plant.

II. GEOLOGY

Based on geology, the Bhilwara district is considered to be a part of the Bhilwara Supergroup (Archean- Lower Proterozoic). The Pre-Aravalli's in Rajasthan, hitherto known as the Banded Gneissic Complex, have been re-grouped by the Geological Survey of India into Bhilwara Supergroup, which forms the oldest stratigraphic horizons on which the entire geological succession of rocks of Rajasthan has developed. Based on magmatic events, lithological homogeneity, and techno-environmental setting, the



rocks of Bhilwara Supergroup have been classified into Sandmata Complex, Mangalwar Complex and Hindoli Group, which are Archean in age and Sawar Group, Pur-Banera Group, Rajpura-

Dariba Group, Jahazpur Group and Ranthambore Group (Table 1) have been considered to be of Lower Proterozoic in age (Prasad et al. 1997).

TABLE - 1

Litho-stratigraphic Succession of Bhilwara Supergroup is showing the position of Pur-Banera Group in the regional setup.

Supergroup	Age	Group
Bhilwara Supergroup	Lower Proterozoic	Ranthambore Group
		Rajpura-Dariba Group
		Pur-Banera Group
		Jahazpur Group
		Sawar Group
	Achaean	Hindoli Group
		Mangalwar Complex
		Sandmata Complex

Pur-Banera Group: In the Pur-Banera group, predominantly chromogenic rocks with bands of clastics occur from the southern direction of the village Banera to the village Samodi in the western direction, covering a distance of eighty kilometers during three kilometers to twelve kilometers wide belt; these are assigned to the Pur-Banera Group. In this group, the rocks are as follows: conglomerate, amphibolite schist, calc-schist, calc-gneiss, calc-silicate marble, dolomitic marble, magnetite quartzite,

garnetiferous mica-schist, hematite quartzite, banded magnetite chert, and carbonate rocks, which associated with sulfide-bearing BHQ and BMQ. The amphibolite facies is shown the grade of metamorphism. The Pur-Banera Group rocks rest on the rocks of Suwana and Potla Formation of the Mangalwar Complex. The Pur-Banera Group of rocks have been sub-divided into 5 formations, Pur, Pansal, Rewara, Tiranga, and Samodi. All the formations come in the study area (Table 2).

TABLE - 2

Geological of Sequence of Pur-Banera Group –litho-stratigraphic succession

Supergroup	Group	Formation	Lithology
	Recent	Recent	Alluvium/Soil
	Intrusives		Amphibolite Dyke
Bhilwara Supergroup	Pur-Banera	Samodi Formation	Amphibolite Dyke intrusives, Mica Schist, Calc-Schist, Marble interband, and Quartzite.
		Tiranga Formation	Sulphide bearing banded Hematite /Magnetite Quartzite.
		Rewara Formation	Calc-Schist, Calc-Gneiss, Calc-Silicate marble, Mica Schist, Amphibolitic Schist, BIF streaks, Quartzite
		Pansal Formation	Conglomerate, Quartzite, Marble.
		Pur Formation	The conglomerate, Quartzite.
	Mangalwar Complex	Potla Formation	Migmatite, Amphibolite, Garnetiferous Mica Schist.
		Suwana Formation	Amphibolite (Granitised); Mica Schist with Amphibolites, Calc-Silicate rock; Quartzite

Geologically two main litho-units that occur in the study area are known as sulfide-bearing banded hematite quartzite and banded magnetite quartzite, which covers the maximum Banded Iron Formation (BIF) disposition belongs to Tiranga Formation of Pur-Banera Group, which is Lower Proterozoic in age. The Tiranga Formation is underlined by the rocks of Rewara Formation, which is composed of calc-gneiss, mica schist, amphibolite schist, BIF streaks, Quartzite, calc-schist, calc-silicate marble and overlain by Samodi Formation, which is composed of Quartzite, quartz mica schist, calc-schist, amphibolite dyke intrusives, and marble.

The hematite/magnetite quartzite and carbonate rock inter-bedded with biotite garnet schist, calc-schist, and calc-gneiss occur as a persistent horizon. The hematite quartzite consists of two individual bands separated by partings of biotite-sericite schist and are folded. The two prominent bands representing a line of asymmetrical fold forming a chain of hillocks are exposed from Tiranga in the south to Dhulkhera in the north and Suras in the south to Dhulkhera in the north and also from Jipiya in the south to Devpura in the north. The hematite and magnetite quartzite is cherty at places, and fractures are filled by secondary silica.

III. OCCURRENCE

In the Rajasthan state, iron-ore deposits are located in the districts of Jaipur, Udaipur, Jhunjhunu, Sikar, Bhilwara, Alwar, Bharatpur, Dausa, and Banswara. The important localities of iron ore are Morija- Neemala (Jaipur), Lalsot (Dausa), Rampura, Dabla (Sikar), Taonda (Jhunjhunu), Pur-Banera, Bigod (Bhilwara), Nathara-Ki-Pal, Thur (Udaipur), Indergarh, Mohanpura (Bundi), Dedrauli, Liloti, Todupura, Khora (Karauli) (DMG Udaipur, Rajasthan).

In Bhilwara district, the 60 km long belt running from Bigod to Jahazpur having bands of hematite quartzite. There are so many old mines in this area in which Bigod is famous for making iron tools and weapons. In the study area, the Pur-Banera belt is 14.2 km long-running from Pur to Banera, having both banded hematite quartzite and banded magnetite quartzite, which is covering the Manpura, Samodi-Tiranga, Dariba-Gurlan, and Surawas areas. This belt belongs to the Bhilwara Supergroup of rocks in which the iron ore occurs in the central part of the Pur-Banera Group, which is known as Tiranga Formation of lower Proterozoic age.

IV. MINING PROCEDURE

The mining techniques can be divided into two common excavation types', i.e., surface mining and sub-surface (underground) mining. However, in the study area, the excavation of iron deposits is through employing surface mining techniques.

Surface mining, including opencast mining, open-pit mining, and mountaintop removal mining, is a broad category of mining during which soil and rocks overlying the mineral deposit (the overburden) are removed, in contrast to underground mining, during which the overlying rock is left in situ, and therefore the mineral is removed through shafts or tunnels.

The working open cast iron ore mine is 11.35 km long in NE-SW direction and 1.0 km to 2.2 km wide in NW-SE direction. This area is situated in the study area of the Pur-Banera iron ore belt explored by GSI in the year 1969-70. The working mine of iron ore body exists in Tiranga hill block, Dhulkhera north block, and Dhulkhera south blocks and in Suras block. In other blocks, these outcrops are concealed under sand covers.

The open cast mine working in Tiranga, Dhulkhera, and Suras block by mechanized method deploying heavy earthmoving machinery like 6.0 m³ capacity shovels having digging depth of 11 meters, 60 tonnes dumpers and 150 mm diameter down-the-hole drills. The benches have up to 10 meters high and 15 meters wide and have connected by ramps having a gradient of 1:10.

According to the online data of previous surveys, the depth of the blast hole was 11m, and spacing and burden were 4.5 m and 4.0 m, respectively. Each hole was charged with 15 Kg (approx) of booster (high explosive) and 60 Kg (approx) of the ANFO mixture. In one round of blast, 3 rows of holes, each row contains 20 holes, 60 holes will be blasted to yield 32,400 tonnes (approx) of muck. Each row was provided with a separate delay. The first row was 1 millisecond, the second row had 2 milliseconds, and the third was having 3 milliseconds delays in providing free face to subsequent rows.

V. STATISTICAL DATA OF IRON ORE

There were two hundred ninety-seven leases of iron ore mine in India in the year 2015-16 in which Rajasthan has eighteen leases with the 2235.09-hectare area, and it is distributed in 7

districts. The names of the district are - Alwar, Bhilwara, Jhunjhunu, Jaipur, Sikar, Kotputli, and Neem Ka Thana (Table 4).

In the year 2016-17, there were eighteen mines engaged in the production of iron ore that produces 35.63 lac tonnes of iron ore and generates a revenue of Rs. 3225.28 lac. Jhunjhunu district has the maximum number of producing mines, i.e., seven, and right next to it has three manufacturing mines in Jaipur and Kotputali, and the third has two producing mines in Bhilwara and Neem Ka Thana. In that year, Bhilwara produces 33,12,056 tonnes of iron ore, while Kotputli, Jhunjhunu, and Neem Ka Thana produced 1,66,000 tonnes, 42,680 tonnes, and 41,500 tonnes of iron ore, respectively.

Also, in the year 2017-18, Rajasthan had eighteen mines captivate in the production of iron ore and produced 34.68 lactones, Iron Ore, while the revenue goes down from the previous year, i.e., Rs.1940.42 lac (Table 3). Jhunjhunu covered the maximum number of manufacturing mines, i.e., seven, and Kotputali & Jaipur stands second with three producing mines, and in the third position, Neem Ka Thana and Bhilwara had two producing mines each. In this year, Bhilwara produces 3204125 tonnes of iron ore, while Kotputli, Jhunjhunu, and Neem Ka Thana produced 205067 tonnes, 39872 tonnes, and 18000 tonnes of iron ore, respectively (Table 4). In terms of sale value, it had increased from Rs.743.82 crore to Rs.1020.74 crore from the year 2016-17 to 2017-18, which shows the rising demand for iron ore in the market.

Now, In Rajasthan, we can see that Bhilwara is a leading district of iron ore in terms of production, sale value, revenue, employment, etc.

From the last few years, Bhilwara stands as a forerunner in Iron Ore statistics in the state of Rajasthan (Table 5). According to the Department of Mines and Geology Rajasthan, in the year 2017-18, Iron ore in Bhilwara covers the 1989.28 hectares area. This area is covered by two mines, and these mines come in the Pur-Banera belt. In this area, we have villages like, i.e., Dhoolkhera north, Dhoolkhera south, Suras, Tiranga, Samodi, and Dhedwas, which are engaged in the production of iron ore. The total production of iron ore is 32.04 lactones, which sale value is Rs. 1009.29 crore, and due to that, it generates total revenue of Rs. 1835.93 lac, and this contribution lead to employing 801 employees (Table 5).

TABLE - 3
Summary report of Iron Ore statistics in Rajasthan in the year 2013-18.

S.No.	Year	Leases	Area	Production	Sale Value	Revenue	Employment
		(No.)	(in Hector)	(Lac' Tons)	(Crore' Rs.)	(Lac' Rs.)	(Nos.)
1	2013-14	16	2214.73	29.832	275.830	2202.321	992
2	2014-15	16	2234.34	57.67	539.80	3908.05	1130
3	2015-16	17	2235.09	41.34	795.12	3084.67	992
4	2016-17	18	2240.10	35.63	743.82	3225.28	899
5	2017-18	18	2240.10	34.68	1020.74	1940.42	833

Source- Rajasthan, Udaipur, DMG

TABLE - 4
Mining Engineer's Office wise statistical report of Iron Ore in Rajasthan in the year 2017-18.

S.No	Office	Leases	Area	Production	Sale Value	Revenue	Employ.
		(No.)	(in Hector)	(Tons)	(Rs.)	(Rs.)	(Nos.)
1	ME Alwar	1	69.37	0	0	0	0
2	ME Bhilwara	2	1989.28	3204125	10092993750	183592800	801
3	ME Jaipur	3	34.48	550	192500	38000	5
4	ME Jhunjhunu	7	102.96	39872	19936000	2285000	11
5	AME Kotputli	3	14.45	205067	58238931	6751999	16
6	AME NeemKa Thana	2	29.56	18000	36000000	1374000	0
	Total	18	2240.10	3467614	10207361181	194041799	833

Source- Rajasthan, Udaipur, DMG

TABLE - 5
Summary report of Iron Ore statistics in Bhilwara District in the year 2013-18.

S.No.	Year	Leases	Area	Production	Sale Value	Revenue	Employ.
		(No.)	(in Hector)	(Tons)	(Rs.)	(Rs.)	(Nos.)
1	2013-14	2	1989.28	2834360	2692642000	215284147	602
2	2014-15	2	1989.28	5592119	5312513050	380973404	785
3	2015-16	2	1989.28	3928951	7857902000	300689234	815
4	2016-17	2	1989.28	3312056	7286523200	314968560	868
5	2017-18	2	1989.28	3204125	10092993750	183592800	801

Source- Rajasthan, Udaipur, DMG

VI. RESERVE/RESOURCES OF IRON ORE

In Rajasthan, the entire resources, i.e., reserve and remaining resources of hematite and magnetite, are 655.31 million tonnes (Table 6). However, from which district Bhilwara has 522 million tonnes that clearly state that Bhilwara is the leading state of Rajasthan (Table 7).

are found in nine districts, i.e., Jaipur, Udaipur, Jhunjhunu, Sikar, Bhilwara, Alwar, Bharatpur, Dausa, and Banswara (Table 8) (Fig. 1). Out of these, the top producers of iron ore are Bhilwara, Kotputli, and Jhunjhunu; among the three, Bhilwara stands as a forerunner in iron ore production in the state of Rajasthan (Table 9) (Fig. 2).

VII. PRODUCTION OF IRON ORE

As per the data from the years 2013-18 as published by DMG, Rajasthan has a total number of eighteen iron ore mines that

The maximum production of iron ore was produced in the year 2014-15 by Bhilwara itself, which makes a new benchmark for Bhilwara. According to the survey, if all conditions go in the favor of mining, Bhilwara mines can cross this benchmark also.

TABLE - 6
Reserve/Resource of Iron Ore (Hematite and Magnetite) in Rajasthan, April- 2015

(In million tonnes)

State/Grade	Reserve			Remaining Resources							Total Resources (A+B)		
	Proved	Probable	Total (A)	Feasibility	Pre-feasibility	Measured	Indicated	Inferred	Reconnaissance	Total (B)			
By States													
Rajasthan Hematite	2.103	2.175	0.38	4.658	8.764	6.105	0.471	0	11.51	6.897	0	33.745	38.404
Rajasthan Magnetite	17.148	2.185	16.09	35.423	0.595	0.46	10.113	0	0	554.904	15.422	581.493	616.916

Figures rounded off.

Source- Indian Bureau of Mines - Indian Minerals Yearbook 2017, 56th Edition Iron Ore - Part- III: Mineral Reviews.

TABLE - 7
Iron Ore reserves of Rajasthan

District	Area	Resources (million tonnes)	Grade (%)
Bhilwara	Pur-Banera belt	522.00 million tonnes up to 05 mts depth	30 to 40 Fe(Beneficiated)
Dausa	Moriya	5.42	60 Fe
Jaipur	Lalsot	3.91	50 to 65 Fe
	Nimla	1.00	56 to 55 Fe
	Ravsola, Bomani	0.13	50 to 55 Fe
	Dabla	0.48	60 Fe
Udaipur	Nathara Ki Pal	14.2	50 Fe
Karauli	Liloti	263.90	25.00 (avg. grade)

(Source: DMG Rajasthan)

TABLE - 8
Production of Iron Ore in Rajasthan.

Year	Alwer	Bhilwara	Jaipur	Jhunjhunu	Kotputli	NeemKa Thana	Total (tonnes)
2013-14	0	2834360	92	65696	40574	42500	2983222
2014-15	0	5592119	0	95628	10181	69505	5767433
2015-16	0	3928951	0	32694	157800	14425	4133870
2016-17	0	3312056	440	42680	166000	41500	3562676
2017-18	0	3204125	550	39872	205067	18000	3467614

(Tonnes)

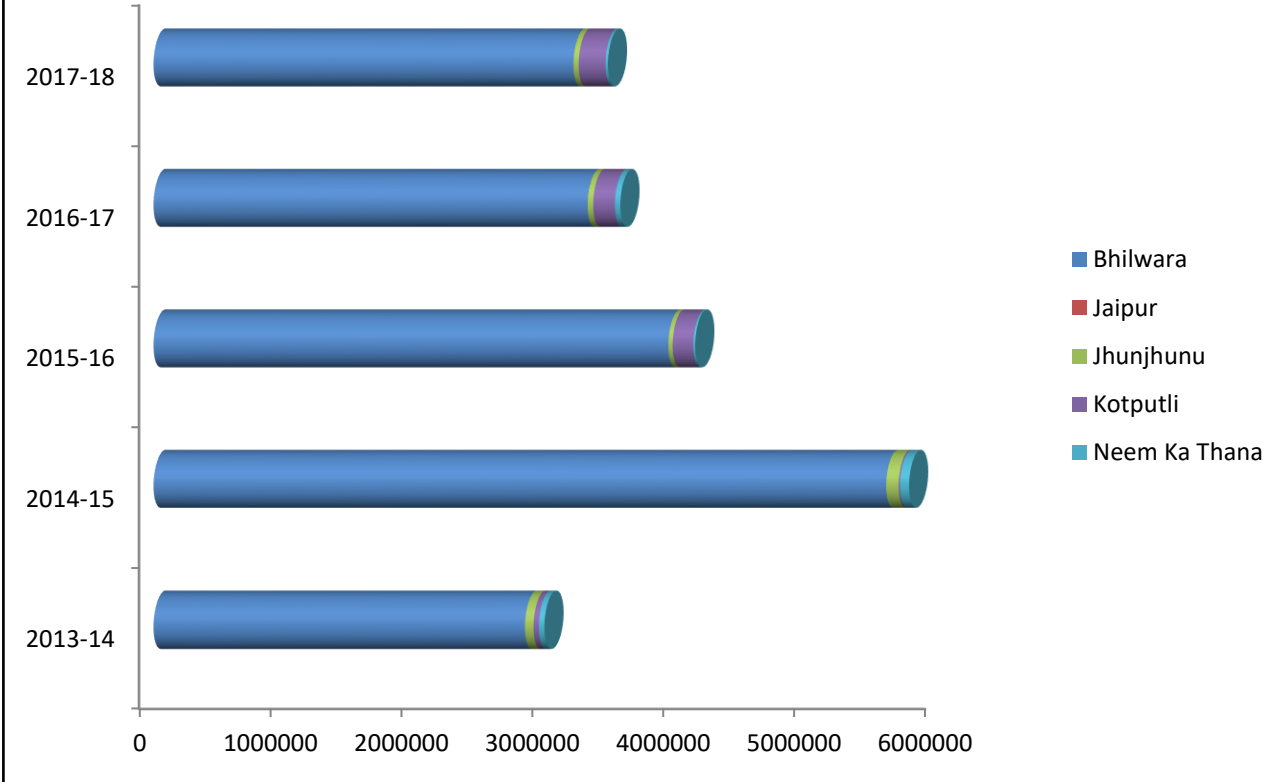
Source: - Rajasthan, Udaipur, DMG

TABLE - 9
Productions of Iron Ore (magnetite and hematite) in Bhilwara in the year 2013-18.

Year	Production (in lakh tonnes)
2013-14	28.34
2014-15	55.92
2015-16	39.39
2016-17	33.12
2017-18	32.04

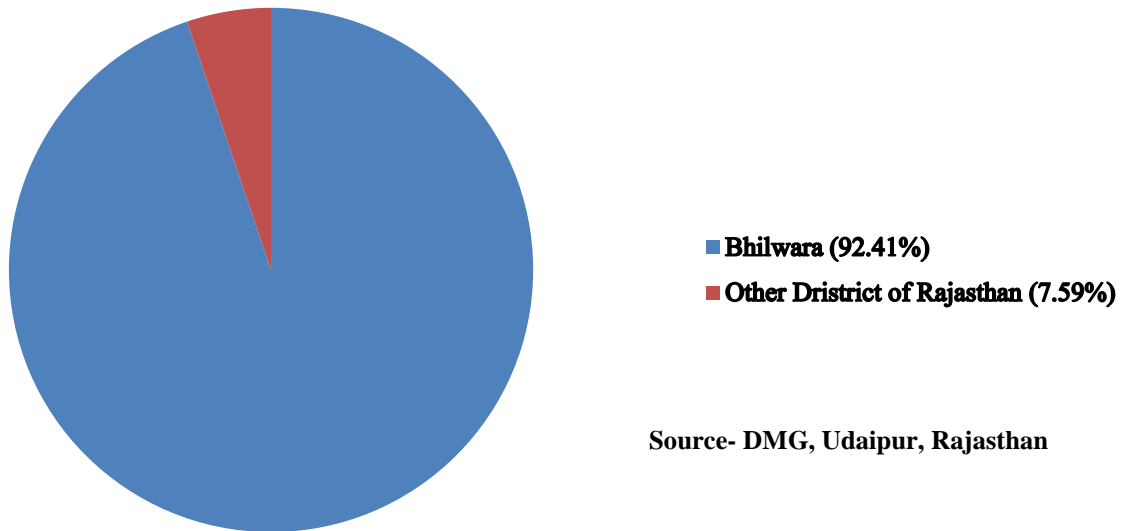
Source: - Rajasthan, Udaipur, DMG

Fig. - 1 Year wise Production of Iron Ore, 2013 - 18



Source- DMG, Udaipur, Rajasthan

Fig. - 2 Contribution in Production of Iron Ore, 2013-18



Source- DMG, Udaipur, Rajasthan

VIII. EMPLOYMENT STATUS

The total mineable reserves of iron ore (hematite and magnetite) in Bhilwara district are 522 million tonnes, and at present, the rate of production of iron ore is around 32.04 lac tonnes to 55.92 lac tonnes per annum. The production of iron ore helps many people to get employment, which is shown in Table 10. In the year 2017-18, 801 people were employed (Table 11), which is approx—96% of the total employment (Fig. 3).

As a result, several government schools, private schools, the market of grocery items, fruits and vegetables, carpentry, blacksmithy, vehicle repair shops, etc. have come in that region. Moreover, due to this, around 2500 peoples are getting profit.

Because of all these facts, we can deduce that iron ore mining is generating employment in the Bhilwara district as well as Rajasthan state.

TABLE – 10
Yearly figures of the employed persons in Rajasthan in Iron Ore Mines.

Year-wise	No. of the person employed
2013-14	992
2014-15	1130
2015-16	992
2016-17	899
2017-18	833

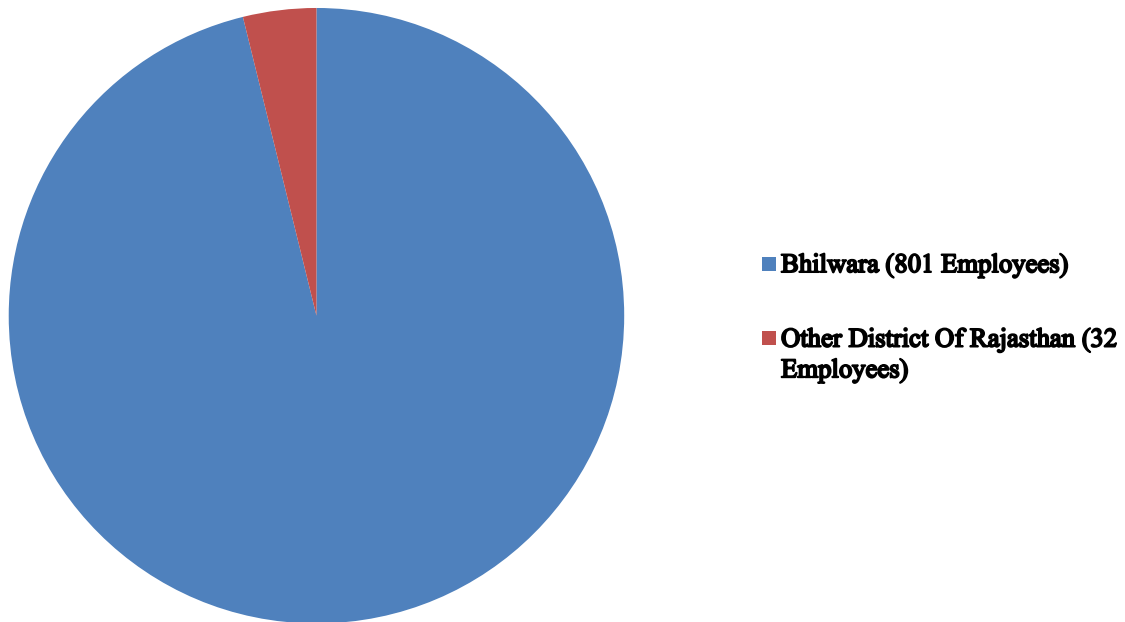
Source: - Rajasthan, Udaipur, DMG

TABLE - 11
District wise figures of the employed persons in Rajasthan, the year 2017-18

District wise (2017-18)	Employment (Nos.)
Kotputli	16
Bhilwara	801
Jaipur	5
Jhunjhunu	11
Total	833

Source: - Rajasthan, Udaipur, DMG

Fig. - 3 Comparison Of Employment Status



Source- DMG, Udaipur, Rajasthan

IX. CONCLUSION

According to the Department of Mines and Geology Rajasthan, in the year 2017 – 18, Bhilwara is a leading district of Rajasthan in terms of area, production, sale value, revenue, and employment generation.

Of a total of 2240.10 hectares, 1989.28 hectares are in Bhilwara district, which is 88.80% of the total. Bhilwara produces 32.04 Lac. Tonnes out of 34.67 Lac. Tonnes in entire Rajasthan, which is 92.41% of the total.

Interestingly Bhilwara has only 2 mines currently engaged while there are a total of 18 mines engaged in Rajasthan. This itself speaks for the production efficiency of Bhilwara when it comes to Iron Ore.

Bhilwara leads in the financial and employment aspect of iron ore. In percent terms, Bhilwara contributes 98.87 % of the total sale value by selling iron ore worth Rs. 1009.29 crore alone while total Rajasthan sells Rs. 1020.74 crore. This sale value of district Bhilwara generates Rs. 1835.93 Lac. In revenue and Rajasthan as whole generate Rs. 1940.42 Lac. This is 94.61 % of the total.

The high revenue also means a high employment generation of a total of 833 people employed in this field, 801 people are in Bhilwara itself.

In conclusion, Bhilwara has established its hegemony in terms of the efficient production of iron ore and revenue and employment from it.

Bhilwara produces 92.41 % of iron ore. Its sale value is 98.87 % of the total. So, this shows that iron ore produced in Bhilwara is more desirable. Similarly, on comparing sales value 98.87 % and revenue 94.61 %, it is worth noticing. Moreover, this shows Bhilwara iron ore is economically more efficient and viable.

But we employ 96.03 % of total people; this shows that in terms of labor efficacy, Bhilwara is better than others.

In Rajasthan, the entire resources, i.e., reserve and remaining resources of hematite and magnetite, are 655.31 million tonnes. From which Bhilwara has 522 million tonnes that clearly state that Bhilwara is the leading state of Rajasthan.

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