

## 42 Gold

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Gold is a noble metal highly valued by mankind since antiquity as an adornment for cultural status and decorative reasons and as a source of wealth and for coinage. It is also owned as an investment. For most consumers, the motivations are intertwined. Gold is a relatively scarce metal in the world and a scarce commodity in India. Properties of gold which make it useful in industry are malleability, ductility, colour, resistance to corrosion, high electrical conductivity, reflecting power and therapeutic effects of some of its salts. India is a minor producer of gold but has huge demand in the country mainly in ornament sector. India has a traditional and stable market for gold consumption. The domestic demand is mainly met through imports of gold.

### RESOURCES

As per UNFC system, as on 1.4.2005, the total resources of gold ore in the country were estimated at 390.29 million tonnes. Out of these, 19.25 million tonnes were placed under reserves category and the remaining 371.04 million tonnes under remaining resources category. Total resources of gold (primary), in terms of metal, stood at 490.81 tonnes. Out of these, 85.12 tonnes were placed under reserves category and 405.69 tonnes under remaining resources category. The resources include placer-type gold ore in Kerala estimated at 26.12 million tonnes containing 5.86 tonnes gold metal. By States, largest resources (57%) are located in Bihar in terms of gold ore (primary) followed by Karnataka, & Rajasthan (17%) each, West Bengal & Andhra Pradesh (3%) each, Madhya Pradesh (2%), etc., while in terms of metal content, Karnataka remained on top followed by Rajasthan, West Bengal, Bihar, Andhra Pradesh, etc. (Table-1).

### EXPLORATION AND DEVELOPMENT

GSI, MECL, HGML, NMDC and DMG, Rajasthan carried out exploration for gold in 2006-07 and 2007-08. Gold, along with other minerals, continued to be the principal thrust area for exploration by GSI in Andhra Pradesh, Chhattisgarh, Jharkhand, Karnataka, Kerala, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal.

MECL carried out exploration for gold in Jharkhand, Madhya Pradesh and Rajasthan. HGML conducted exploration in its mining lease areas; viz, Hutti, Hira-Buddini and Uti Gold Mines in Raichur district in Karnataka. DMG, Rajasthan carried out exploratory work in Banswara, Jaipur, Dungarpur and Rajsamand districts. Details of exploration activities undertaken in 2006-07 and 2007-08 by various exploratory agencies are furnished in Tables - 2(A) and 2(B), respectively.

### PRODUCTION AND STOCKS

The production of gold ore at 692 thousand tonnes in 2007-08 increased by 35% as compared to that in the previous year. The quantity of ore treated increased from 556 thousand tonnes to 569 thousand tonnes showing an increase of 2% as compared to previous year. Four mines reported production of gold ore in 2007-08 as compared to three mines in 2006-07.

The average grade of gold ore produced in India during 2007-08 was 4.68 g/t as against 5.12 g/t in 2006-07. However, the average grade of ore treated during the year under review was 4.49 g/t as against 4.60 g/t in 2006-07.

Total production of gold (primary & secondary) in 2007-08 at 2,858 kg increased by about 14.9% as compared to that in the preceding year.

Production of primary gold in 2007-08 at 2,858 kg increased by 21% as compared to that in the previous year. No production of secondary gold was reported during 2007-08 at smelter of HCL in Jharkhand as against 127 kg production in the previous year.

HGML, a Karnataka State Government Undertaking, was the leading producer of gold accounting for 99% of the total production. The remaining production was reported from Jharkhand by Manmohan Industries Ltd, a private sector company (Tables - 3 to 7).

In addition, around 10.33 tonnes and 9.14 tonnes of secondary gold was recovered from imported copper concentrates during 2006-07 and 2007-08, respectively, by Birla Copper Complex of Hindalco at Dahej in Bharuch district, Gujarat.

The average daily employment of labour in 2007-08 was 4,028 as against 2,943 in the previous year.

**Table – 1 : Reserves/Resources of Gold as on 1.4.2005  
(By Grades/States)**

(In tonnes)

Grade/State	Reserves			Remaining resources						Total resources (A+B)	
	Proved STD111	Probable		Total (A)	Pre-feasibility STD222	Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334		Total (B)
		STD121	STD122								
<b>All India : Total</b>											
Ore (Primary)	15554089	1075868	2623994	19253951	1724132	27062651	83529855	118635315	140083333	371035286	390289237
Metal (Primary)	66.92	3.8	14.4	85.12	6.74	62.08	118.4	52.74	165.73	405.69	490.81
Ore (Placer)	-	-	-	-	-	-	2552000	23569000	-	26121000	26121000
Metal (Placer)	-	-	-	-	-	-	2.29	3.57	-	5.86	5.86
<b>By States</b>											
<b>Andhra Pradesh</b>											
Ore (Primary)	655133	-	889515	1544648	-	8200000	661000	1692699	-	10553699	12098347
Metal (Primary)	2.45	-	3.57	6.02	-	17.28	0.69	7.59	-	25.56	31.58
<b>Bihar</b>											
Ore (Primary)	-	-	-	-	-	-	27042744	101842116	94000000	222884860	222884860
Metal (Primary)	-	-	-	-	-	-	3.33	18.27	16	37.6	37.6
<b>Chhattisgarh</b>											
Ore (Primary)	-	-	-	-	-	-	600000	300000	-	900000	900000
Metal (Primary)	-	-	-	-	-	-	1.8	0.9	-	2.7	2.7
<b>Jharkhand</b>											
Ore (Primary)	-	-	92850	92850	-	-	-	254000	-	254000	346850
Metal (Primary)	-	-	0.83	0.83	-	-	-	2.29	-	2.29	3.12
<b>Karnataka</b>											
Ore (Primary)	14898956	1075868	1641629	17616453	1724132	3676371	7914931	1990500	33250000	48555934	66172387
Metal (Primary)	64.47	3.8	10	78.27	6.74	17.43	20.12	5.12	25.73	75.14	153.41

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Table - 1 (Concl.d.)

Reserves	Remaining resources						Total resources (A+B)				
	Proved STD111	Probable STD121	Probable STD122	Total (A)	Pre-feasibility STD222	Measured STD331		Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)
<b>Kerala</b>											
Ore (Primary)	-	-	-	-	-	462280	96180	-	-	558460	558460
Metal (Primary)	-	-	-	-	-	0.17	0.03	-	-	0.2	0.2
Ore (Placer)	-	-	-	-	-	-	2552000	23569000	-	26121000	26121000
Metal (Placer)	-	-	-	-	-	-	2.29	3.57	-	5.86	5.86
<b>Madhya Pradesh</b>											
Ore (Primary)	-	-	-	-	-	-	5375000	1947000	-	7322000	7322000
Metal (Primary)	-	-	-	-	-	-	5.59	2.22	-	7.81	7.81
<b>Maharashtra</b>											
Ore (Primary)	-	-	-	-	-	-	-	1517000	-	1517000	1517000
Metal (Primary)	-	-	-	-	-	-	-	3.55	-	3.55	3.55
<b>Rajasthan</b>											
Ore (Primary)	-	-	-	-	-	14724000	41840000	9025000	-	65589000	65589000
Metal (Primary)	-	-	-	-	-	27.2	84.55	14.09	-	125.84	125.84
<b>Tamil Nadu</b>											
Ore (Primary)	-	-	-	-	-	-	-	67000	-	67000	67000
Metal (Primary)	-	-	-	-	-	-	-	1	-	1	1
<b>West Bengal</b>											
Ore (Primary)	-	-	-	-	-	-	-	-	12833333	12833333	12833333
Metal (Primary)	-	-	-	-	-	-	-	-	124	124	124

Figures rounded off.

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**Table – 2(A) : Details of Exploration Activities for Gold, 2006-07**

Agency State/District	Location	Mapping		Drilling		Sampling	Remarks and Reserves/Resources estimated
		Area (sq km)	Scale	No. of boreholes	Meterage		
<b>GSI</b>							
<b>Andhra Pradesh</b>							
Cuddapah	Veligallu greenstone belt	-	Detailed mapping	-	-	168	Samples showed gold concentration ranging from 0.02 to 0.21 g/t. Results of trench samples are awaited.
Nellore	Southwestern part of Nellore schist belt	-	Large scale mapping	-	-	-	Samples gave gold values ranging from 0.03 to 0.07 g/t.
Kurnool	Aspari	-	-do-	-	-	106	Brecciated and silicified quartz reef was demarcated. Samples of soil & pit indicated gold values ranging from 0.03 to 0.45 g/t.
<b>Chhattisgarh</b>							
Raipur	Baghmara Block	-	-	-	-	13	Drilling indicated continuation of gold mineralisation in western part. Samples indicated mineralised zone of 5 m width gold values ranging from 0.20 to 2.1 g/t. The item is completed.
<b>Jharkhand</b>							
Ranchi	Hepsel-Lungtu	-	-	-	-	-	Boreholes indicated several mineralised zones. Analytical results are awaited.
-do-	Kothadih Sindauri	-	-	-	-	-	The boreholes indicate six mineralised zones. Few grains of gold were recorded at 100 m. depth (4.05 g/t x 2.00m)
-do-	Saraiakela Kharswan	-	Large scale mapping	-	-	60	Pitting, trenching and sampling were carried out. Analytical results are awaited.
West Singhbhum	Sausal Hingung Sector	-	Detailed mapping	-	-	100	Analytical results of 25 samples have been received which are not encouraging.
-do-	Pahardih Block	-	-	3	-	-	Investigation was continued in the eastern region. Core samples were sent for analysis. Analytical results are awaited.
<b>Karnataka</b>							
Dharwad & Uttar Kannad	Maruthipura Attigere	-	-	-	-	-	Analysis of samples indicated gold values ranging from 0.02 to 1.49 g/t .
Dharwad	Bangargatti Block (Shimoga Schist belt)	-	-	-	-	-	Five mineralised zones were demarcated for a strike length of 140 to 550 m. In North & South sectors bedrock & trench samples indicated gold values ranging from 0.03 to 35.00 g/t.

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Table - 2(A) (Contd.)

Agency State/District	Location	Mapping		Drilling		Sampling	Remarks and Reserves/Resources estimated
		Area (sq km)	Scale	No. of boreholes	Meterage		
Tumkur	Ajjanahalli block	-	-	12	-	-	<p>Analysis of core samples indicated gold values ranging between 0.78 and 1.2 g/t. A tentative resource of gold ore of about 0.1 million tonnes with a grade of 1.65 g/t Au was estimated from Ajjanahalli Central sector.</p> <p>In Ajjanahalli East block (North sector) a resource of 0.38 million tonnes of gold ore having 1.7 g/t Au was estimated. Thus, the total resource of this block has been augmented from 0.293 million tonnes in 2005-06 to 0.673 million tonnes in 2006-07 with an average grade of 1.83 g/t Au.</p> <p>In Ajjanahalli East block - North Extension and South sector, detailed mapping, trenching and sampling were conducted. The continuation of all the six mineralised bands in already explored North sector block was established.</p> <p>In Ajjanahalli Central block, strike continuity of six mineralised zones was established. Analytical results indicated gold values ranging from 0.05 to 10 g/t.</p>
<b>Kerala</b> Wayanad	Mananthwadi Talapuzha	-	Large scale mapping	-	-	-	Trenching plot a 14m wide wards vein in southern part of Edathil.
<b>Maharashtra</b> Bhandara	Umarjhari	-	-	-	-	-	The investigation was carried out by mapping, trenching and pitting. A zone of quartz grain was identified by stream sediment sampling. Analytical results are awaited.
<b>Rajasthan</b> Ajmer and Bhilwara	Bhatiwar-Borana- Raipur; Surgati- Kumeri; Raipur- Ghata areas	-	-	-	-	-	Analytical results of stream sediments and bed rock samples from Bhatiwar-Borana-Raipur and Surgati-Kumeri areas did not indicate any gold mineralisation. However, samples from Raipur-Ghata area showed anomalous gold values ranging from 0.05 to 0.07 g/t.
Ajmer, Bhilwara and Tonk	Piparoli, Ekalsingha and Sarwar areas	-	-	-	-	-	During the ground evaluation of airborne geophysical anomalies gold values ranging from 0.11 to 0.43 g/t were recorded.

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Table - 2(A) (Contd.)

Agency State/District	Location	Mapping		Drilling		Sampling	Remarks and Reserves/Resources estimated
		Area (sq km)	Scale	No. of boreholes	Meterage		
Banswara	Delwara West block (Bhukia gold belt)	-	-	-	-	-	The mineralised zones exposed in the Western part of the area have been explored during field study in 2005-06 and 2006-07. Analytical results of core samples indicated that width of the mineralised zone varies from 1.12 to 16.65 m with gold values ranging from 0.64 to 4.49 g/t. Besides, gold, Cu mineralisation of thickness 1 to 7 m containing 0.12 to 0.89% Cu is also recorded. A gold ore resource of 4.78 million tonnes with 1.32 g/t gold has been estimated. In Delwara block a resource of 1.3 million tonnes of gold ore has been augmented during 2006-07 (Hence, total resource of gold ore in Delwara block stands to be 14.9 million tonnes). In addition, to these in Khankariya Gara block a resource of 1.24 million tonnes of gold ore with 0.96 g/t Au has been estimated. Thus, the total resource of gold ore in Bhukiya gold belt is augmented from 47.9 million tonnes to 55.22 million tonnes with an average grade of 1.87 g/t gold.
-do-	Gundelpara block (Bhukiya gold belt)	-	-	2	-	-	In one borehole two auriferous zones containing 1.06 to 1.87 g/t Au and in other borehole an auriferous zone containing 1.06 to 1.67 g/t Au were intersected.
-do-	N-W and S-E of Village Gundelpara (Bhukiya gold belt)	-	-	-	-	-	Analytical results of channel samples indicated 29 ppm to 0.78% Cu; <25 ppb to 0.12% Co; <50 to 238 ppm Zn and <25 to 229 ppm Ni. The analytical results of other channel samples indicated gold values ranging from 0.05 to 0.54 g/t.
-do-	Pathara block	-	-	-	-	-	Drilling indicated sporadic dissemination of sulphides.
Chittorgarh	Jabarkiya block	-	-	-	-	-	Analysis of borehole samples revealed stray values of gold between 0.11 and 0.21 g/t besides copper.
Udaipur	Dugocha main block and Dugocha North block	-	-	-	-	-	An additional resource of 0.16 million tonnes of gold ore was estimated.

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Table - 2(A) (Concl.d.)

Agency State/District	Location	Mapping		Drilling		Sampling	Remarks and Reserves/Resources estimated
		Area (sq km)	Scale	No. of boreholes	Meterage		
<b>Tamil Nadu</b>							
Krishnagiri	Naripally	-	-	-	-	-	Investigations carried by mapping, trenching/pitting. Analytical results of samples indicated gold values from 0.03 to 0.41 g/t.
<b>Uttar Pradesh</b>							
Jhansi	Babina	-	-	-	-	-	Preliminary search was carried out by mapping & sampling. Analytical results are awaited.
<b>West Bengal</b>							
Bankura	Rudra	- Large scale mapping		-	-	-	The host rock for gold is mafic & felsic volcanic rocks. Traversed by quartz vein. Results of stream sediments analysis showed gold flakes. The soil samples showed values of gold from 0.03 to 0.04 g/t.
<b>MECL</b>							
<b>Madhya Pradesh</b>							
Balaghat	Ghari-Dongri	-	-	5	801	2184	Mineralised quartz vein established over a strike length of 2 km.
<b>DMG, Rajasthan</b>							
Banswara	N/V Lorda	150.00	1:50,000	-	-	60	Results of analysis are awaited.
	Kushalgarh.	10.00	1:2,000	-	-	699	Anomalous values of gold (0.16 ppm to 1.5 gm) have been found near Dhanol and Bokhla.
Dungarpur	Padar-Amjhera	5.00	1:10,000	-	-		
		0.50	1:2,000	-	-		
Rajsamand	Johron-ka-Khera	200.00	1:50,000	-	-	138	Analysis of samples from the area near Puthol showed 98.1 ppm Ag & 0.162 ppm Au.
	Gangrar Teh.	10.00	1:10,000	-	-		
		0.15	1:2,000	-	-		
Udaipur	Lai,	205.00	1:50,000	-	-	170	Analysis of samples from old working pit reveals gold values of 0.12 to 2.75 ppm.
	Kodarwadia	21.00	1:10,000	-	-		
		1.50	1:2,000	-	-		
<b>HGML, Karnataka</b>							
Raichur	Hutti mines	3167 (U/G)	1:400	NA	721.0	13459	About 893.00 cu m exploratory mining was done. Probable & Proved resources of about 8.27 million tonnes containing 6.04 g/t Au were estimated.
-do-	Uti mines	3.00	1:2,000	-	-	1417	About 66.25 cu m exploratory mining was done. Probable & Proved reserves of about 0.507 million tonnes containing 2.53 g/t Au were estimated.
-do-	Hira Buddini	0.36	1:1,000	-	-	3372	About 904.90 cu m exploratory mining was done. Reserves of about 0.45 million tonnes containing 5.50 g/t Au were estimated.

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Table – 2(B) : Details of Exploration Activities for Gold, 2007-08

Agency State/District	Location	Mapping		Drilling		Sampling	Remarks and Reserves/Resources estimated
		Area (sq km)	Scale	No. of boreholes	Meterage		
<b>GSI</b>							
<b>Andhra Pradesh</b>							
Cuddapah	Shivapuram and Gutamidapalle blocks	-	-	-	-	-	Sulphide mineralisation was noticed. Analytical results so far obtained indicated gold values from 32 ppb to 0.44 g/t.m.
Nellore belt.	SW margin of Nellore schist	-	-	-	-	446	Samples have shown anomalous gold values ranging from 30 ppb to 0.21 g/t. The item is completed.
Warangal	Ghanpur Schist belt	-	-	-	-	205	Stream sediment samples indicated gold values from 25 to 88 ppb. Analytical results of trench samples are awaited.
<b>Chhattisgarh</b>							
Raipur	Baghmara Block	-	-	-	-	-	A resource of 0.09 million tonnes was estimated with average gold value of 0.93 g/t.
<b>Jharkhand</b>							
Ranchi	Hepsel-Lungtu	-	-	4	-	-	Four mineralised zones were identified with gold values ranging from 0.65 to > 1.0 g/t. Analytical reserves of other samples are awaited.
Ranchi	Kotadih Sindauri	-	-	6	-	-	Analytical results indicated 4 mineralised zones. Gold values ranging between 0.30 g/t and 4.0 g/t. Results of core samples are awaited.
Saraiakela Kharswan & Ranchi	Chhota Nagpur & Dalma	-	-	-	-	-	Analytical results of bedrock samples received so far indicated gold values from 50 ppb to 1.0 g/t. The stream and trenched samples indicated gold values from 0.10 g/t to > 1.0 g/t.
<b>Karnataka</b>							
Dharwad & Uttar Kannad	Maruthipura Attigere	-	-	-	-	264	Nine BIF bands were traced having 2 to 16 m width. Analytical results indicated gold value ranging from 0.22 to 1.57 g/t.
Dharwad	Bangargatti Block	-	Detailed mapping	-	-	235	Detailed mapping delineated 3 bands which are silicified, Sheared and oxidised. Analytical results of samples are awaited.
Tumkur	Ajjanahalli block B (Previously Ajjanahalli East block - Central sector)	-	-	14	-	-	Six zones of mineralisation were identified. Two zones one are promising having persistent gold values. Core samples analysed gold values from 0.439 g/t to 1.82 g/t.

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Table - 2 (B) (Contd.)

Agency State/District	Location	Mapping		Drilling		Sampling	Remarks and Reserves/Resources estimated
		Area (sq km)	Scale	No. of boreholes	Meterage		
Tumkur	Ajjanahalli block C	-	Detailed mapping	-	166.7	-	Weak mineralised zone intersected This block was merged with block-E.
-do-	Ajjanahalli block D (Previously Ajjanahalli Central sector)	-	-do-	-	-	-	Mapping and trenching have shown 8 parallel zones. A maximum gold value of 4.11 g/t was recorded.
<b>Rajasthan</b>							
Banswara	Delwara West block (Bhukia gold belt)	-	-	-	-	-	During field study in 2007-08, a resource of 5.36 million tonnes of gold ore with 2.09 g/t Au in Delwara West block was established. Subsequently, the total gold ore resource in Bhukiya area has been augmented from 55.22 million tonnes with 1.87 g/t Au to 60.58 million tonnes with 1.89 g/t Au.
-do-	Gundelpara block (Bhukiya gold belt)	-	-	7	-	-	Core samples indicated presence of 1.5 m thick gold mineralised zone with 1.05 g/t Au.
-do-	N-W and S-E of (Bhukiya gold belt)	-	-	-	-	-	Channel samples indicated several mineralised zones containing 1.19 g/t to 3.6 g/t Au and 0.05 to 1.2 % Cu.
Dungarpur	Bharkundi area	-	-	-	-	-	The analytical results indicated gold content up to 1.0 g/t.
Udaipur	Dugocha West Block	-	-	3	-	-	Boreholes intersected significant zones of sulphide mineralisation.
<b>Tamil Nadu</b>							
Tiruvannamalai	Kelur and Chengam areas	-	-	-	-	-	Samples were collected. Analytical results of the samples are awaited.
<b>West Bengal</b>							
Bankura	Rudra	-	-	-	-	-	The analytical results of soil samples indicated gold values from 25 ppb 1.44 g/t. One bedrock sample analysed gold values > 1.0 g/t.
<b>MECL</b>							
<b>Jharkhand</b> Ranchi	Parasi (Central)	1.0	1:1,000	9	1709	133	1.5 to 4.0 m thick mineralised zone with 1.48 to 3.26 g/t of Au is established.

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Table - 2 (B) (Concl'd.)

Agency State/District	Location	Mapping		Drilling		Sampling	Remarks and Reserves/Resources estimated
		Area (sq km)	Scale	No. of boreholes	Meterage		
<b>Rajasthan</b> Banswara	Bhukiya	0.50	1:1,000	9	1763	2043	Three gold bearing lodes were identified over 700 m strike length with 2.0 g/t of gold upto 250 m depth.
<b>DMG Rajasthan</b> Banswara	N/V Kharwa, Unalwala	100 10 1.2	1:50,000 1:10,000 1:2,000	-	-	28	Gold indications were noted in dolomite, graphitic schist.
-do-	N/V Padar, Amjhora	50 10 1	1:50,000 1:10,000 1:2,000	-	-	22	Indications of gold, iron ore and manganese ore were noted.
Jaipur	N/V Gumanpura Ramsinghpura, etc.	15	1:10,000	-	-	869	Analytical results are awaited.
-do-	Matasula Gol, Pachapur, etc.	20 2.5	1:10,000 1:2,000	-	-	48	Analytical results revealed presence of Cu, Ag and Au.
<b>HGML Karnataka</b> Raichur	Hutti mines	5520 (U/G)	1:400	45	1423	11500	About 5520.00 cu m exploratory mining was done. Probable & Proved resources of about 8.27 million tonnes containing 6.04 g/t Au were estimated in 2006-07.
-do-	Uti mines	3.00	1:2,000	-	-	3965	Probable & Proved reserves of about 1.759 million tonnes containing 2.50 g/t Au were estimated.
-do-	Hira Buddini	4.06	1:1,000	-	-	3197	About 0.45 million tonnes mineable reserves containing 5.25 g/t Au were estimated.

**Table – 3 : Producers of Gold, 2007-08**

Name and address of the producer	Location of the mine	
	State	District
The Hutti Gold Mines Co. Ltd, No. 6/13, Guruappa Avenue, Primrose Road Cross, Bangalore-560 025, Karnataka.	Karnataka	Raichur
Manmohan Industries (P) Ltd Shantiniketan, 286, New Patliputra Colony, Patna, Bihar.	Jharkhand	Singhbhum East

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**Table – 4 : Production of Gold Ore  
2006-07 and 2007-08  
(By States)**

State	(In tonnes)			
	2006-07		2007-08 (p)	
	Ore produced	Ave. Grade (gram/tonne)	Ore produced	Ave. Grade (gram/tonne)
<b>India</b>	<b>512609</b>	<b>5.12</b>	<b>692338</b>	<b>4.68</b>
Karnataka	501340	5.17	684993	4.69
Jharkhand	11269	2.9	7345	3.60

**Table – 5 : Gold Ore Treated  
2006-07 and 2007-08  
(By States)**

State	(In tonnes)			
	2006-07		2007-08(p)	
	Ore treated	Ave. Grade (gram/tonne)	Ore treated	Ave. Grade (gram/tonne)
<b>India</b>	<b>555996</b>	<b>4.60</b>	<b>568985</b>	<b>4.49</b>
Karnataka	545301	4.62	561747	4.50
Jharkhand	10695	3.09	7238	3.51

**Table – 6 : Production of Gold\*, 2005-06 to 2007-08  
(By States)**

(Quantity in kg; value in Rs.'000)

State	2005-06		2006-07		2007-08(p)	
	Quantity	Value	Quantity	Value	Quantity	Value
	<b>India</b>	<b>3047</b>	<b>2822796</b>	<b>2488</b>	<b>2290925</b>	<b>2858</b>
<i>Primary Gold</i>	<i>2880</i>	<i>2700033</i>	<i>2361</i>	<i>2173412</i>	<i>2858</i>	<i>2825920</i>
Karnataka	2846	2677014	2334	21483439	2831	2799422
Jharkhand	34	23019	27	25063	27	26498
<i>Secondary Gold</i>	<i>167</i>	<i>122763</i>	<i>127</i>	<i>117513</i>	-	-
Jharkhand <sup>@</sup>	167	122763	127	117513	-	-

\* Recovered from indigenous ores.

<sup>@</sup> Secondary gold is recovered as by-product from copper slime.**Table – 7 : Production of Gold\*, 2006-07 and 2007-08  
(By Sectors/States/Districts)**

(Quantity in kg; value in Rs. '000)

State/District	2006-07			2007-08 (p)		
	No. of mines	Production		No. of mines	Production	
		Quantity	Value		Quantity	Value
<b>India</b>	<b>3</b>	<b>2488</b>	<b>2290925</b>	<b>4</b>	<b>2858</b>	<b>2825920</b>
Public sector	2	2461	2265862	3	2831	2799422
Private sector	1	27	25063	1	27	26498
<i>Primary Gold</i>	<i>2</i>	<i>2361</i>	<i>2173412</i>	<i>3</i>	<i>2858</i>	<i>2825920</i>
<b>Karnataka</b>	<b>2</b>	<b>2334</b>	<b>2148349</b>	<b>3</b>	<b>2831</b>	<b>2799422</b>
Raichur	2	2334	2148349	3	2831	2799422
<b>Jharkhand</b>	<b>1</b>	<b>27</b>	<b>25063</b>	<b>1</b>	<b>27</b>	<b>26498</b>
Singhbhum East	1	27	25063	1	27	26498
<i>Secondary Gold</i>	-	<i>127</i>	<i>117513</i>	-	-	-
<b>Jharkhand</b>	-	<b>127</b>	<b>117513</b>	-	-	-
Singhbhum East @	-	127	117513	-	-	-

\* Recovered from indigenous ores.

<sup>@</sup> Secondary gold is recovered as by-product from copper slime.

## Gold Bullion

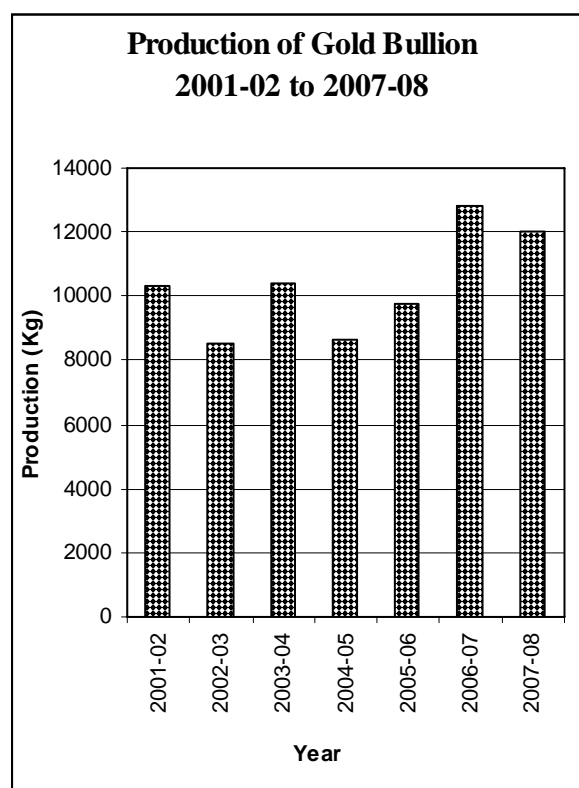
Production of gold bullion in India is reported both in primary and secondary forms. Total production of gold bullion during 2007-08 at 11,993 kg decreased by about 6% as compared to 12,823 kg in the previous year (Table - 8).

**Table – 8 : Production of Gold Bullion\***  
**2005-06 to 2007-08**

(Quantity in kg; value is Rs. '000)

Year	Quantity	Value
2005-06	9757	7341107
2006-07	12823	11684714
2007-08(p)	11993	11425612

\* Includes gold recovered as by-product from copper concentrates by Hindalco Industries Ltd and HCL.



## MINING & MILLING

Presently, HGML is the only public sector company continued to produce and Manmohan Industries Pvt. Ltd in private sector is also engaged in mine production of gold in the country. HGML operates mines at Hutti, Uti and Hira-Buddini in Raichur district, Karnataka. The total installed capacity of these mines is 7.1 lakh tpy gold ore. Implementation of mechanisation of mining operations at Hutti mine was in progress and opencast mining down to 60 m vertical depth had been planned as per the feasibility studies carried out. However, the existing underground Hutti gold mine has gone to a depth of 800 m (up to 24th level). The Uti mine is opencast and the ore from this mine is transported to Hutti mine for processing at the mills. As per the feasibility studies, opencast mining is viable and will be continued to 60 m vertical depth. Underground exploratory mining has just started. Hira-Buddini gold unit is under exploratory mine development and deepening and re-equipping of main shaft. The present exploratory mine development work is in progress by using manual compressed air jackhammer drilling and electrical hoist for winding in the shaft. Based on the development work and feasibility, the locomotive loaders, wagon drills and other required machinery will be used to increase the OMS. It is planned to carry out detailed exploration by exploratory development to 6th level (about 600 m). At present, 4th and 5th level exploratory mining is in progress.

Other mine of HGML is at Manglur in Gulbarga district, Karnataka. The mining activities of HGML at Chitradurga were suspended since 1.12.2002, due to unoxidised banded iron formation encountered during mine development causing ore recovery problem as well as non-availability of technology for recovery of gold.

At the Hutti Mineral Treatment Plant, the r.o.m. of -8" size is crushed. The final product from crushing plant; i.e., -10 mm size is stored in a 1,500 tonnes capacity fine ore bin for subsequent treatment; i.e., grinding. The Milling/Grinding process of gold ore employs two distinct grinding techniques. In the first technique, grinding is done in two stages; i.e., primary grinding and then

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secondary grinding for further comminution. One primary mill and three tube mills constitute one stream of grinding in which pebble and smaller size balls are used as composite grinding media. There are two such streams and strake tables are used to collect coarse gold as concentrate for this circuit. In the second technique, grinding is done by four ball mills of different sizes and each of them is independent circuit in which large size balls are used as grinding media. In these circuits, Knelson concentrator is used to collect coarse gold as concentrate. In all, the milling techniques, cyclones are in close circuits with the mills so as to get the required sizes (80% passing 75micron) for the subsequent treatment process.

The concentrate collected from both the techniques is upgraded on James Table. The upgraded concentrates are roasted, magneted and finally smelted into bullion buttons.

All the cyclone overflow; i.e., finely ground ore in the form of slurry from the two streams of first technique and 4 streams of second technique join together in a distributor box from which finely ground ore slurry is fed to High Rate Thickener for thickening purpose. The thickened pulp (60% solid w/w) thus obtained from thickeners is subjected to cyanidation process in which cyanide accessible gold in slurry makes complexes with cyanide in presence of oxygen and dissolves in solution at high pH. To increase the oxygen potential of slurry,  $H_2O_2$  is added in addition to compressed air. The cyanidation or leaching process is carried in a series of mechanically agitated agitators of different sizes.

The cyanide leached pulp is then fed to two Carbon-in Pulp (CIP) plants. The CIP plants are of 1,000 tpd size each and are parallel in circuit. The objective of CIP plant is to absorb the dissolved gold in activated carbon from the solution.

The gold-loaded carbon is removed from the CIP plant periodically, subjected to acid and alkaline wash and then eluted in four elution columns with 1.0% NaOH and 0.1% NaCN solution at 95°C for a period of 60 hours. The solution is then passed through four electrowinning cells in which gold is deposited on steel wool cathodes.

The gold loaded steel wool cathodes are manually removed periodically, subjected to acid digestion, drying and smelting to obtain bullion buttons. The bullion buttons thus obtained from table concentrate and steel wool are cast into bullion bars weighing 4 to 11 kg and then despatched for sales.

Manmohan Industries, a private sector company, operates Kunderkocha mine in Singhbhum East district, Jharkhand. The mining is carried out by underground method.

In the past, gold was produced by the Central Government undertaking; namely, BGML. BGML earlier mined and processed the ore from Chigargunta reef in Chittoor district, Andhra Pradesh, Mysore mines of Kolar Gold Fields in Karnataka and Yeppamana mine in Anantapur district, Andhra Pradesh. All activities of BGML were stopped and BGML was closed w.e.f. 1.3.2001 under Section 25 (O) of the Industrial Disputes Act, 1947 in terms of Ministry of Labour, Government of India's order dated 29.1.2001. To augment gold production in the country, as per XI Plan document, Chigargunta and Bisanthan mines deserve active consideration for opening.

## DEVELOPMENT

HGML was the 40th member of the World Gold Council and also enjoyed reputation as the first one from India.

The Deccan Gold Mines Ltd (DGML), India's first and largest listed gold exploration company, collected rock and stream sediment samples and analysed them. DGML has plans for geophysical studies and drilling prospects located in proximity to existing old mines as also earlier explored areas in Hutti belt, Manglur belt, Dharwar-Shimoga belt in Karnataka; Attapadi Project in Kerala and Ramgiri belt in Andhra Pradesh. The structure of rock formations and types of rocks in these prospects are similar to those in Australia where major gold discoveries have been made. The presence of old workings by ancient civilisations and presence of gold in rocks and stream sediments found during sampling and chemical analysis thereto were the

reason for increasing interest of global mining companies in India. DGML is understood to have filed RP applications in Andhra Pradesh, Kerala and Karnataka, PL applications in Andhra Pradesh, Chhattisgarh, Kerala, Karnataka and ML applications in Andhra Pradesh, Karnataka and Rajasthan.

Birla Copper Complex of Hindalco Industries Ltd situated at Dahej, Dist. Bharuch, Gujarat has an installed capacity of 15 tpy for gold recovery from imported copper concentrates. In 2006-07, it produced 10.33 tonnes gold and about 9.14 tonnes in 2007-08.

The HCL is recovering by-product secondary gold from indigenous copper ores at its ICC plant in Jharkhand. The installed capacity of the gold recovery plant is 698 kg per annum while the production in 2006-07 was 127 kg. No production was reported in 2007-08.

Sterlite Industries (India) Ltd, has a copper smelter of 3 lakh tpy capacity at Tuticorin, Tamil Nadu. The Company is in the process of obtaining world class technology for recovery of minor metals from copper concentrates and copper smelter by-products.

## **GOVERNMENT POLICY**

Foreign Direct Investment (FDI) up to 100% in mining sector in respect of gold is eligible for automatic approval.

Gold being a specified mineral, Mineral Concessions, viz, reconnaissance permits (RP), prospecting licences (PL), and mining leases (ML) for gold are granted by the State Governments after prior approval of the Central Government.

The Government announced Foreign Trade Policy (FTP), 2004-09 w.e.f. 1.9.2004. In the revised import-export policy w.e.f. 1.4.2008 comprised in the FTP, gold ores and concentrates are transferred to freely importable category. The import of non-monetary gold metal also falls under Free category subject to RBI regulations while import of gold metal in monetary form is restricted.

## **ENVIRONMENTAL CONCERNS**

Placer gold mines obviously cause environmental damage. Hydraulic mining involves high-power blasts of water from hoses to break gravels and also to move them to gold concentrating system. This causes water pollution. Gold is recovered from ores by two main methods, both of which affect environment. Earlier, for recovery of gold, amalgamation processes were used in which ore was mixed with mercury that selectively dissolved gold which was then recovered by evaporation. Mercury from these operations was never recovered and remained as pollutant in many old mining areas. The cyanide process is based on the property of precious metals of forming soluble complex ions with cyanide anion. Cyanide does not dissolve quartz, iron oxides and other common gangue minerals and yields a relatively simple gold-bearing solution known as pregnant solution. In some gold mines, gold is dissolved from the ore by crushing and grinding followed by mixing with cyanide solution in large vats.

Gold is sometimes recovered from the pregnant solutions by adding zinc to form soluble zinc cyanide and precipitate gold and silver. The pregnant solutions can also be passed with activated carbon which absorbs dissolved gold. Gold from either process is cast into bars, bullion and dore (when it contains silver), which must be further refined to remove impurities, such as mercury, arsenic and copper. Some ores cannot be treated by cyanide processing because gold is in small inclusions or even in solid solutions in minerals, such as pyrite. This gold is generally recovered by roasting which converts pyrite into porous iron oxides, containing small grains of gold that can be dissolved by cyanide.

Cyanide is a highly toxic compound. Although it is found in common plants, such as almond and cassava, concentration in solutions is higher and requires special handling. During ore treatment, pH of cyanide solution must be

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kept at about 11 to prevent cyanide from reacting with hydrogen ion to produce HCN, a deadly gas. Although less toxic substitutes of cyanide are known, it is not yet clear whether such substances will be cost-effective or environment-friendly.

### DEMAND & CONSUMPTION

Jewellery accounted for major consumption of gold; i.e., 85%, followed by electronics 6%, medal and coins 2% and other sectors 7%. Apparent consumption of gold in the country during 2007-08 was about 694 tonnes. No proper estimation of gold demand in the country could be attempted due to lack of proper consumption data of the end-use industry. However, from overall evaluation it is seen that India has a traditional and stable market for gold consumption. There is increase in demand from ornamental and electronic sector. A huge gap exists between demand and indigenous production which is likely to continue.

### SUBSTITUTES

Platinum and palladium substitute gold to some extent but their use is influenced by price relationship and by an established consumer preference for gold. Silver can be a substitute, but it offers less resistance to corrosion. Gold-plated palladium and bright tin-nickel can be used in electronics. Titanium and chromium-based alloys can be used in dental work. High prices encourage substitutes, particularly base metal clad with gold in electronic & electrical industry and in jewellery products. No metal or alloy substitute has all the properties of gold and emphasis is on reduction of gold content rather than substitution.

### WORLD REVIEW

The estimated reserve base for gold was about 90,000 tonnes metal. Out of the total world resources of gold, 15 to 20% was obtained as a by-product during extraction of other metals. In addition, ground stocks of 34,000 tonnes of previously mined gold was held by Central Banks and 74,000 tonnes was available in the form of coin, bullion, jewellery and scrap. The world reserve base of gold is given in Table-9.

The world mine production of gold was estimated at 2,340 tonnes in 2007. About 74% world mine production of gold came from only ten countries. China contributed about 12% in world's total mine production of gold followed by South Africa, Australia and USA (10% each), Peru & Russia (7% each), Indonesia (5%) and Canada (4%) (Table - 10).

**Table – 9 : World Resources of Gold  
(By Principal Countries)**

(In tonnes of gold content)	
Country	Reserve base
<b>World : Total (rounded)</b>	<b>90000</b>
Australia	6000
Canada	3500
China	4100
Indonesia	2800
Peru	4100
Russia	3500
South Africa	36000
USA	3700
Other countries	26000

*Source : Mineral Commodity Summaries, 2008.*

**Table – 10 : World Mine Production of Gold  
(By Principal Countries)**

(In tonnes of metal content)			
Country	2005	2006	2007
<b>World : Total</b>	<b>2490</b>	<b>2350</b>	<b>2340</b>
Australia	263	247	245
Canada	121	104	102
China @	255	248	270
Ghana	67	72	84
Indonesia	143	85	118
Papua New Guinea	68	58	58
Peru	208	203	170
Russia	163	159	157
South Africa	295	272	252
USA	256	252	244
Uzbekistan	84	77	73
Other countries	567	573	567

*Source: World Mineral Production, 2003-2007.*

@ *Metal production.*

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### Australia

After a slight increase in 2005, Australia showed lowest level in gold production in 2006 since 1992. The production was 247 tonnes down by 16 tonnes or 6%, as compared to previous year. Further decrease to 245 tonnes was observed in 2007.

### Brazil

The production rose to 49,600 kg in 2007 from 40,075 kg in 2006. The country's large mines namely Mineracao, Serra Grande and Paracatu maintained stable output. The growth in production was fuelled by start of three new mines namely Sao Francisco, Amapari and Palito mine.

### China

China's gold production hit an all time high becoming world leader and increasing by 9% to 270 tonnes as compared to the previous year. The policy changes conducive to liberalisation of market continued to show positive impact on gold mining sector.

### Ghana

In 2006, the production rose to 72 tonnes and later to 84 tonnes in 2007. The start of Ahafo mine in mid-2006 and Chirano (which started in October 2005) made the additional outputs taking the production to 4-year high.

### Indonesia

Gold production nose-dived to 85 tonnes in 2006. A sharp decline in the production at Grasberg Copper-gold mine dominated the country's lower production. In 2007, it again increased to 118 tonnes showing an increase of 39%. The impact of this was further complimented by higher production recorded by remaining mines in the country.

### Peru

During 2006, the production dipped modestly to 203 tonnes. Further decrease in production was reported in 2007 to 170 tonnes, a decrease by 16%. Production at Yanacocha mine contracted by 22%. Peru continued to be the biggest producer of gold in Latin America.

### South Africa

The total production declined by 23 tonnes in 2006 to 272 tonnes due to closures and suspensions or scaling down of number of shafts in order to stem losses and preserve the reserves at mining centres. The decline in production was also due to an accident at South deep in May 2006 when a loaded ore skip fell down the twin shaft during routine maintenance procedure. Further decline by 7% was reported in 2007 relegating the top producer to second position after China.

### USA

At 252 tonnes, USA was second biggest producer of gold in the world in 2006. Moderate fall was reported in production. The Cortez joint venture was solely responsible for half of the country's gross reduction in production. The production further decreased to 244 tonnes relegating the country to fourth position.

## FOREIGN TRADE

### Exports

There was no export of gold ores and concentrates in 2007-08. However, in 2006-07 about 25,771 kg gold ores & concentrates were exported to Republic of Korea. Exports of gold (non-monetary & monetary) increased to Rs. 18.76 crore in 2007-08 from Rs. 4.55 crore in the previous year. In terms of exports value, other unwrought forms accounted for 54% share and other semi-manufactured for 46% share. Exports in 2007-08 were mainly to Hong Kong (Tables - 11 to 16).

### Imports

Imports of monetary and non-monetary gold were 698.41 tonnes valued at Rs. 67,339.20 crore in 2007-08 as against 715.82 tonnes valued at Rs. 65,439.88 crore in the previous year. In 2007-08, share of non-monetary other unwrought forms was 64% in total value of gold imported and that of gold non-monetary (other semi-manufactured forms) was 36%. Imports of gold were mainly from Switzerland (48%), followed by Australia (17%), UAE (15%) and South Africa (11%) in terms of value (Tables - 17 to 21).

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**Table – 11 : Exports of Gold Ores & Conc.  
(By Countries)**

Country	2006-07		2007-08	
	Qty (kg)	Value (Rs. '000)	Qty (kg)	Value (Rs. '000)
<b>All Countries</b>	<b>25771</b>	<b>740351</b>	-	-
Korea, Republic of	25771	740351	-	-

**Table – 12 : Exports of Gold (Non-Monetary & Monetary) : Total  
(By Countries)**

Country	2006-07		2007-08	
	Qty (kg)	Value (Rs. '000)	Qty (kg)	Value (Rs. '000)
<b>All Countries</b>	<b>2747</b>	<b>45450</b>	<b>4128</b>	<b>187615</b>
Switzerland	-	-	1	101064
Hong Kong	11	8327	4073	66473
USA	2711	13785	47	18597
Singapore	-	-	4	1120
Korea, Republic of	-	-	1	322
Nepal	-	-	2	39
Honduras	2	1830	-	-
Nigeria	1	573	-	-
UAE	21	20899	-	-
UK	1	36	-	-

**Table – 13 : Exports of Gold, Non-Monetary, Other Unwrought Forms  
(By Countries)**

Country	2006-07		2007-08	
	Qty (kg)	Value (Rs. '000)	Qty (kg)	Value (Rs. '000)
<b>All Countries</b>	<b>11</b>	<b>9462</b>	<b>2</b>	<b>101111</b>
Switzerland	-	-	1	101064
USA	-	-	1	47
Honduras	2	1830	-	-
Hong Kong	9	7632	-	-

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**Table – 14 : Exports of Gold, Non-Monetary : Other Semi-manufactured Forms  
(By Countries)**

Country	2006-07		2007-08	
	Qty (kg)	Value (Rs. '000)	Qty (kg)	Value (Rs. '000)
<b>All Countries</b>	<b>2715</b>	<b>15089</b>	<b>4124</b>	<b>86465</b>
Hong Kong	2	695	4073	66473
Korea, Republic of	-	-	1	322
Nigeria	1	573	-	-
Singapore	-	-	4	1120
UK	1	36	-	-
USA	2711	13785	46	18550

**Table – 15 : Exports of Gold, Non-Monetary : Powder  
(By Countries)**

Country	2006-07		2007-08	
	Qty (kg)	Value (Rs. '000)	Qty (kg)	Value (Rs. '000)
<b>All Countries</b>	<b>21</b>	<b>20899</b>	<b>2</b>	<b>39</b>
Nepal	-	-	2	39
UAE	21	20899	-	-

**Table – 16 : Exports of Gold-Clad Metals/Base Metals, NES  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs. '000)	Qty (t)	Value (Rs. '000)
<b>All Countries</b>	<b>22</b>	<b>2991</b>	<b>62</b>	<b>442</b>
Nepal	-	-	62	393
Canada	-	-	++	22
USA	++	1565	++	21
Mauritius	-	-	++	6
Qatar	++	292	-	-
Saudi Arabia	20	697	-	-
St. Helena	1	19	-	-
Thailand	1	112	-	-
UK	++	306	-	-

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**Table – 17 : Imports of Gold (Non-Monetary & Monetary) : Total  
(By Countries)**

Country	2006-07		2007-08	
	Qty (kg)	Value (Rs. '000)	Qty (kg)	Value (Rs. '000)
<b>All Countries</b>	<b>715817</b>	<b>654398761</b>	<b>698413</b>	<b>673592027</b>
Switzerland	371286	338525122	333936	321254968
Australia	132963	122166355	118233	112893668
UAE	79058	73300461	106691	103494383
South Africa	71823	65610676	79181	77107323
USA	2810	2250118	18125	16514975
Hong Kong	21177	19623455	15383	15603273
UK	14455	12743221	5861	6082465
France	855	778653	5327	5131768
Indonesia	2976	2827263	2466	2429607
Sweden	10303	9047260	411	358153
Other countries	8111	7526177	12799	12721444

**Table – 18 : Imports of Gold, Non-Monetary : Powder  
(By Countries)**

Country	2006-07		2007-08	
	Qty (kg)	Value (Rs. '000)	Qty (kg)	Value (Rs. '000)
<b>All Countries</b>	<b>7</b>	<b>3733</b>	<b>251</b>	<b>287843</b>
Germany	1	25	-	-
Switzerland	5	3689	250	287646
USA	1	19	1	197

**Table – 19 : Imports of Gold, Non-Monetary : Other Semi-manufactured Forms  
(By Countries)**

Country	2006-07		2007-08	
	Qty (kg)	Value (Rs. '000)	Qty (kg)	Value (Rs. '000)
<b>All Countries</b>	<b>298709</b>	<b>273887116</b>	<b>257065</b>	<b>244594639</b>
Australia	70118	64583667	50239	46257797
France	855	778653	4972	4817012
Hong Kong	2726	2586379	2512	2346607
Indonesia	2461	2346831	1842	1780490
South Africa	16388	15267461	27121	25925118
Sweden	3980	3384864	7	8535
Switzerland	152904	140151286	120160	115032678
UAE	34686	32143138	30063	29559652
UK	9445	8292984	3521	3291709
USA	1620	1165691	10114	9362860
Other countries	3526	3186162	6514	6212181

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**Table – 20 : Imports of Gold, Non-Monetary : Other Unwrought Forms  
(By Countries)**

Country	2006-07		2007-08	
	Qty (kg)	Value (Rs. '000)	Qty (kg)	Value (Rs. '000)
<b>All Countries</b>	<b>417101</b>	<b>380507867</b>	<b>441097</b>	<b>428709545</b>
Switzerland	218377	198370147	213526	205934644
UAE	44372	41157323	76628	73934731
Australia	62845	57582688	67994	66635871
South Africa	55435	50343215	52060	51182205
Hong Kong	18451	17037076	12871	13256666
USA	1189	1084408	8010	7151918
UK	5010	4450237	2340	2790756
Japan	600	525720	1450	1262444
Sweden	6323	5662396	404	349618
Unspecified	1106	1009511	889	1036187
Other countries	3393	3285146	4925	5174505

**Table – 21 : Imports of Gold-Clad Metals/Base Metals, NES  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs. '000)	Qty (t)	Value (Rs. '000)
<b>All Countries</b>	<b>++</b>	<b>2308</b>	<b>++</b>	<b>13324</b>
USA	++	2182	++	6629
Germany	-	-	++	6593
UK	++	64	++	52
Italy	-	-	++	50
China	++	62	-	-

## FUTURE OUTLOOK

India is a traditional and stable market for gold consumption. The present and future production of gold will not be sufficient to meet the ever increasing demand. Therefore, efforts will be required to reduce the gap between production and demand. Some strategies have been planned in XI<sup>th</sup> Five Year Plan for gold exploration and production. The existing gold extraction plant at

HGML is to be replaced by Rs. 70 crore new plant, inclusive of Falcon Gravity separator. To augment gold production during XI<sup>th</sup> Plan period Chigargunta and Bisanathan mines in KGF which were abandoned, deserve active consideration for reopening. Small deposits are being planned for cluster mining and potential areas of 110,740 sq km for gold mineralisation have been identified for further search for gold.