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Artisanal and small scale mining in India: selected studies and an overview of the issues

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In India, mining is one of the main economic activities since time immemorial, giving rise to a long historical tradition of artisanal mining. As modern mining rose during the colonial occupation, artisanal mining activities began to be overlooked and this great tradition became obscure. This invisibility, added with confusion with regard to legally accepted definitions has enhanced the negligence of the artisanal mining sector in India. This study draws attention to the contemporary artisanal mining practices in India – both traditional and non-traditional ones – with regard to four commodities, gold, tin, coal and lignite, and gemstones. It briefly discusses the occurrences of such mining, their salient features and concludes with four specific recommendations. Our recommendations primarily deal with the need for creation of a broader information base, delineating a responsible body to deal with this kind of mining, legal reforms leading to definitional changes and finally, the recognition of the poverty alleviation potential of this sector in view of the Millennium Development Goals.

Keywords: artisanal mining; definitions; legal reforms; database; India

1. Introduction

With a long history of mining dating back to 400 BC[1], a time when all mining must have been what we mean now as 'artisanal', there is considerable uncertainty in India as in many other countries, about the exact definition of Artisanal and Small Scale Mining or ASM as it is commonly understood in international parlance. The reason is also the history of mining expansion in India in modern times, especially the developments during the colonial and post-colonial times when modern large-scale mining became popular and institutions with the Western form of knowledge of geology, exploration and mining were established. Consequently, ASM and related activities became less important in India, at least from a government viewpoint. The other reason is of course economic; in the national economic picture, mineral revenues constitute only a small part. Although India is currently one of the major mining countries of the world, this fact does not show up in the breakdown of its GDP because of low capital accumulation from many of these mines and the fact that the small quarries and traditional mineral acquiring and processing activities are part of the 'informal sector' of Indian economy which, according to some

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experts, can be as high as ~88% [1] of the told output. This kind of scenario is however changing rapidly after globalization and liberalization of the economy has been initiated.

Artisanal mining however, becomes important because together, these mines employ a very large number of people, living at a low level of incomes. In most of these mines, often little or no machines except simple tools are used in the processes, every stage of processing being literally done by the human hand. Again, the importance also lies in the range of minerals mined under ASM in India, beginning from gemstones and gold to low value bulky products, such as gravels, sand and building stones. Whereas the stones are meant primarily for local or domestic consumption, some of these products can have high values and serve non-local markets, such as the gemstones and marble from Rajasthan. Even low value products such as stones may eventually be exported although the exact amount of revenue earned by them is unrecorded. Consequently, some of the traditional practices have continued in various forms to date.

Currently in India, there is considerable variety of mining practices, making a distinction between 'artisanal' and 'small scale' mining (SSM) possible. SSM in India is in most places carried out with acquired mining rights under some statutory control. Some SSM may be carried out illegally without a license or after the expiry of the permit, or even on old and abandoned mine sites. The SSM sector, organized with mining rights and a range of permissions (see [2] for a list of the steps to go through to open a small mine), is not negligible to Indian economy. Artisanal mining, on the other hand, is carried out by indigenous communities in remote locations on and from common lands. Such mining is generally unauthorized as it is unlicensed, and commonly seen as illegal. Strictly speaking, it might be better to describe such mining non-legal as often the operations are beyond the purview of the law. For example, panning for gold from the alluvium on the Subarnarekha riverbed in Jharkhand state is a non-legal artisanal activity, carried out mostly by local indigenous communities that would fall in the non-legal domain. The situation is complicated by the lack of quantitative data, and the confusion over jurisdiction and definition.

In this study, we intend to give an overview of the ASM sector in India and delineate the major issues concerning these mines as a first step towards building policy-interventions. We begin with an outline of history, then go into an analysis of existing definitions, before drawing out some case studies and finally we discuss the legal and policy concerns related to these mines. The present overview is a result of personal experiences of the authors and discussions with resource persons. Therefore, it is necessarily biased and surely incomplete.

2. History of artisanal mining in India

Arthashastra [3] gives detailed instructions on the examination of gems that are to be entered into the Treasury, and on conducting mining operations and manufacture. It describes not only the methods of testing gems, but also of methods of extracting minerals from hard and soft ore bodies, and of making gold and silver coins from the metals thus obtained: 'Mines which yield such minerals as are made use of in preparing vessels (*bhanda*) as well as those mines which require large outlay to work out may be leased out for a fixed number of the shares of the output or for a fixed rent (*bhagena prakrayena va*). Such mines as can be worked out without much outlay shall be directly exploited (by governmental agency)'. From the documentation, it can be assumed that mining was a well-organised activity around that time in India. So was illegal mining. *Arthashastra* also gives instructions on dealing with illegal mining: 'A mine labour who steals mineral

products except precious stones shall be punished with a fine of eight times their value. Any person who steals mineral products or carries on mining operations without license shall be bound (with chains) and caused to work (as a prisoner)'.

The capital city of Delhi, referred to as Indraprastha in the epic Mahabharata, stands in the middle of the Gangetic plains on the edges of Delhi ridge, a part of the Aravalli ranges, predominantly made of quartzite. The series of empires that used this location as a capital used partly local stones to build the forts, palaces and mosques. Besides building stones, the mining of which seems to be ubiquitous, there were precious metals such as gold and silver, and the mining of precious and semi-precious gemstones. For gemstones, Rajasthan has been well-known since the early times, although no official records can be produced to confirm the claim. This is because of poor record keeping habits of ancient India, which was always famous for its oral traditions. However, indirect evidences such as place names are often indicative of mining: Panna in central India has been a centre for diamonds (although *panna* means emerald), Katni in Central India has been the centre for limestone quarrying. Similarly, Jhalda in the eastern fringe of Chotanagpur plateau has been a point for iron works.

Quite a few industries grew up based on the quarries. The tradition of making gold and silver jewelry, and using well-cut and polished gemstones in them gave rise to a line of expert craftsmen and artisans. This has now metamorphosed into the diamond cutting-polishing industry of Mumbai and Surat. Limestone quarries gave rise to *chuna* factories, preparing the essential ingredient in making the cementing material for use in buildings or for human consumption in betel leaves.

India was in the forefront of metal mining in the ancient world. There is hardly any metal deposit found in India in recent times where there was no ancient mining activity. In fact, ancient mines and pits are the best recognition criteria for a potential ore zone in modern geological exploration. Large scale ancient mining activity is noted today in Khetri Copper belt, near Singhana, in Rampura-Agucha zinc deposit in Bhilwara district, in Rajpura-Dariba in Rajsamand district and in Zawar area in Udaipur district of Rajasthan. Zawar has the distinction of having a large ancient smelting township which attracted research by a team from the British Museum. However, with the advent of British rule and introduction of modern legal frameworks of resource ownership, many of the old systems were destroyed and a new system of artisanal mining came into existence. The legal frameworks that we discuss in the next section were established during the colonial times to control the mineral resources of India by the British state. Colonial mining brought in European models of labour relations and management techniques, and altered many of the earlier systems. Consequently, the traditional artisanal mining became invisible and in some cases illegal.

Currently (as per 2002 data), India has a total mining lease hold area of over 624 thousand hectares (excluding fuel and atomic minerals), in its 328 million hectares of landmass (0.19% of area), comprising nearly 9000 mining leases granted by state governments. These comprise an important segment and a contributing factor to the well-being of the economy of India. Among the states, Gujarat has the highest percentage of land under (non-coal, only metallic and non-metallic minerals) mining leases (16.31%), followed by Andhra Pradesh (15.61%), Rajasthan (14.73%), and Madhya Pradesh (13.02%), with Karnataka and Tamil Nadu trailing far behind at around 5.7% each [4]. However, the leasehold area is largest in the state of Rajasthan (22.18%), Orissa (15.32%), Karnataka (9.10%), Andhra Pradesh (7.30%) and Jharkhand (7.24%) [4]. This indicates that the size of mining leases vary widely in the country, with Madhya Pradesh having a

large number of leases in a smaller (5.36%) area. Conversely, a large area is under mining in states like Jharkhand, but the size of operation of these leases are relatively smaller.

3. Definitional confusion

Although there is still no internationally agreed definition of ASM, country specific definitions do exist, reflecting locally relevant situations and developments [5]. As noted before, the ASM sector in India is wide-ranging in mining practices, size, legality and production, giving rise to significant confusion over its definition. Let us first discuss the various definitions available in India. The Mines and Minerals (Regulation and Development) (MMRD) Act of 1957[2] is the main legal framework governing the mines besides the Indian Mines Act of 1952 which is primarily meant for labour welfare and safety and health issues. The MMRD Act and any other mining development plan are guided by the overall National Mineral Policy[3] first outlined by the Government of India in 1993, revised in 2002. It states in the beginning:

> Minerals are valuable natural resources being finite and non-renewable. They constitute the vital raw materials for many basic industries and are a major resource for development. Management of mineral resources has, therefore, to be closely integrated with the overall strategy of development; and exploitation of minerals is to be guided by long-term national goals and perspectives. In this context the need has been felt to spell out in a statement the different elements of the policy, which has evolved over the years, relating to development of our mineral resources and in regard to areas of concern which have emerged in recent years.

The objectives of this policy are manifold, but it is apparent from the statements below that artisanal mining does not figure in any of the recognized areas of 'mineral development'.

(a) to explore for identification of mineral wealth in the land and in off-shore areas;
(b) to develop mineral resources taking into account the national and strategic considerations and to ensure their adequate supply and best use keeping in view the present needs and future requirements;
(c) to promote necessary linkages for smooth and uninterrupted development of the mineral industry to meet the needs of the country;
(d) to promote research and development in minerals;
(e) to ensure establishment of appropriate educational and training facilities for human resources development to meet the manpower requirements of the mineral industry;
(f) to minimise adverse effects of mineral development on the forest, environment and ecology through appropriate protective measures; and
(g) to ensure conduct of mining operations with due regard to safety and health of all concerned.

Besides this official negligence to artisanal mining, other areas of confusion arise from the classification of minerals themselves into two categories, major and minor. In Section 3e, The MMRD Act defines minor minerals as meaning 'building stones, gravel, ordinary clay, ordinary sand other than sand used for prescribed purposes, and any other mineral which the Central Government may, by notification in the Official Gazette, declare to be a minor mineral' [6]. The Indian Bureau of Mines[4] (IBM), working under the MMRD Act is important for two reasons; first it classifies all minerals into two categories, major and minor, and second, it gives the responsibility of developing the minor minerals to the concerned State Governments. The IBM does not maintain statistical data pertaining to

the minor minerals' production, but, for the purpose of employment of technically qualified personnel, identified (Rule 42 of Mineral Conservation and Development Rules, 1988) yet another two categories: Category A and Category B, decided on the basis of labour employment and the standard of mechanical equipment used. Neither of these two categories is specifically defined as SSM although Category B comprises the smaller mines which together constitute about ~88% of the reported mines producing about 10% of the total value of mineral production of the country. The situation is then complicated by the fact that IBM provides production-related data on the basis of two categories of minerals: fuel minerals (petroleum, coal and lignite) which were exclusively reserved till recently for the government to operate, and non-fuel minerals which may include important minerals such as gold, copper and diamond.

Some researchers [7] described the artisanal and small mines as 'those whose production, or excavation quantity is limited in tonnage and not very large, mostly manually operated and sometimes employing machines to small capacity. Such mining activities are usually confined to deposits which are shallow in depth and small in extent'. The salient features of ASM as evident from this discussion are small production and income, labour intensiveness, community level operation with semi or unskilled workforce, shallow nature of deposits, and low technology deployment. The National Institute of Small Mines (NISM) defined the categories of mines in India according to their production, a system which is clearly meant for low value bulky products such as stone[5]. These averaged production figures would be inadequate for classifying high-value metals such as gold.

4. Status of ASM in India

Artisanal mining in India represents an informal, illegal and unregulated system of small-scale mining by local communities, similar to those prevalent in some of the world's poorest countries and as such does not figure in the official records. Due to inadequate facilities and illegal operations, artisanal miners do not make large profits out of their activities. The artisanal miners even risk their own lives in these often unsafe mining operations to make a livelihood to support their families. Further, the ASM activities are often seasonal and are taken in conjunction with other means of livelihood, such as agricultural labour. Some of the profits earned out of mining actually go into the hands of middlemen due to the poor organisation of the economy. The National Mineral Policy of India mentions 'Small Deposits' (7.12) only once in passing: 'Efforts will be made to promote small scale mining of small deposits in a scientific and efficient manner while safeguarding vital environmental and ecological imperatives. In grant of mineral concessions for small deposits in Scheduled Areas, preference shall be given to the Scheduled Tribes'. This mention does not differentiate between traditional and non-traditional artisanal practices and small businesses such as quarries. It is also notable that no mechanism of such preference has yet been set in place.

Because of the poor economic status of the artisanal miners and their low, often insufficient productivity, high value commodities like precious or rare metals and gemstones or essential natural resources like coal are the main targets of the artisanal miners. However, the mining activities of these artisanal miners do not follow any rules and regulations. It is due to this that these types of mining activities result in obvious environmental problems like mercury pollution in surface water and surface degradation. However, despite these problems, this type of mining activity provides sustenance to economically backward, often indigenous communities with no social securities. From the

point of view of sustainability, deposits often considered uneconomic by modern industries are commonly mined by artisanal communities over a long period of time helping alleviation of their poverty to some extent.

As a result of this, it is the small scale as well as artisanal sector that constitute 95 – 98% of the entire mining activities in India. In reality, the large-scale mines contribute only about 2% of the mining activity in India [8].

5. Overview of some ASM activity in India

Among the forty different minerals exploited by small-scale miners, the most important minerals in terms of value exploited by artisanal mining are as follows:

- Gold (both lode and placer deposits),
- Tin,
- Gemstones,
- Coal and lignite.

In this section, we give some primary information about the artisanal mining activities concerning the above commodities. Several other minerals are widely mined in India through artisanal practices; they include sand from riverbeds, various stones as building material, lime and *kankar* (lateritic nodules). However, we have focused only on the four minerals due to the fact that they are high-value products and essential commodities meant to be 'major' minerals, sold mostly in local markets for small profits, and are mined by local communities both traditionally and non-traditionally. The information has been collected through existing literature such as newspaper reports, personal field surveys and interviews with local resource persons.

The vast majority (95 – 99%) of all metallic and primary gemstone deposits are hosted by Precambrian (>542 million years old) rocks in India (Figure 1). As a result, all the mining activity for the first three commodities whether in the primary source rocks or in the secondary alluvial tracts, are restricted to the terrains underlain by Precambrian rocks. Coal is restricted to the Gondwana rocks (~ 300 million years old) while lignite is found in Tertiary rocks (~ 40 million years old).

5.1. Gold

The distribution of gold deposits in India is presented in Figure 1. India has nine major mining leases of gold, covering an area of 6708 primarily in Karnataka, producing 3049 kg of gold bullion in 2002 – 2003 [9]. The gold deposits are clustered in the southern part of the country, geologically known as the Dharwar Craton. Besides the leasehold mining, extensive artisanal mining is carried out in this region. The rest of the known primary gold occurrences are somewhat scattered. In central India they are mostly in the Mahakoshal belt in eastern Uttar Pradesh or in the Sakoli basin of Maharashtra. In eastern India the gold deposits are mostly in the Singhbhum region of Jharkhand state. In the west some gold occurrences are known in the Banswara district of Rajasthan. Unfortunately, no published statistics are available as to production of artisanal gold in all these areas.

Intensive artisanal mining of alluvial gold is practiced by local villagers in the Maru river (a tributary of the Wyanganga) bed near Bhiwapur in the Nagpur district of Maharashtra. The primary gold – copper vein occurrences of these alluvial concentrations are found in the Pular-Parsori prospects in the region.

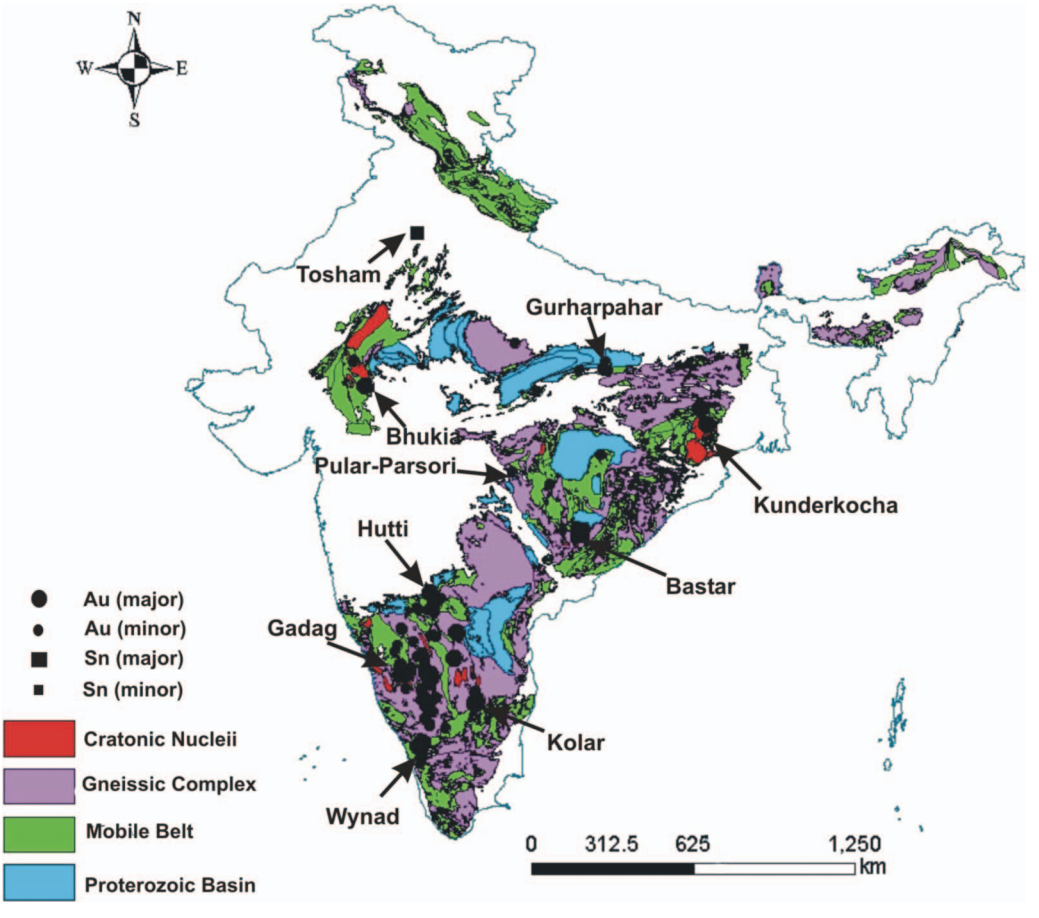

Figure 1. Map of India showing the distribution of Precambrian rocks in India. Location of gold and tin deposits are also shown. Available in colour online.

In the Jharkhand state, illegal mining of auriferous quartz reefs has been carried out by the local mafia for many years in the Kundarkocha mines, probably with the connivance of the district authorities. Nearby in the wide alluvial tract of the Subarnarekha River alluvial gold mining of artisanal scale is being carried out by the local communities, but has flourished since the construction (and consequent displacement of villagers) of Subarnarekha dam. A large number of these artisanal miners are local indigenous peoples and women form a major segment of these workers. In the monsoon season, the state government leases small areas to the local communities on a daily basis and recovers a small sum in royalty. The coarseness of the gold in the alluvium of Subarnarekha River does not require its extraction by mercury amalgamation. It also implies that the transportation of the gold from its primary source has been rather limited. One such source is presumably in the Lawa and Mysera areas in the Dalma hills, where gold reserves have been studied by the Geological Survey of India. In the north, Rampur in Himachal Pradesh, in the downstream of the meandering Sutlej River, between Nugli and Baila, alluvial mining of gold is carried out by local communities, after the monsoon season.

Within the Dharwar craton of south India (Figure 1), the Wynad Gold field in the contiguous parts of Tamil Nadu and Kerala states has extensive artisanal mining sites for

gold. The location of the primary mines/prospects along with the alluvial workings of the Nilambur area is presented in Figure 2. The abandoned adits and mines in the Pannur, Pandalur-Devala areas (Figure 3(a)) of Tamil Nadu are being illegally worked in an artisanal scale by local communities who also carry out the mining activities through newly dug fox holes (Figure 3(b)) and vertical pits in the primary gold-bearing quartz reefs within granulite facies metamorphic rocks. The mining practice is totally primitive and the miners take heavy risks by going down dangling bamboo ladders without any head protection. The broken pieces of auriferous quartz are brought up to the surface in small baskets carried on their heads and collected in piles for further crushing and panning.

Alluvial gold mining is also carried out extensively in the adjacent region in Kerala. It is practiced in Nilambur and Wynad areas [10] by the Paniyar tribe (Figure 4) through alluvial panning along various streams all year round, while in Attapaty valley in the Palakkad district it is often undertaken after the rains. The gold in all these activities is extracted by mercury amalgamation.

A survey of the artisanal mining practices in some of the abandoned mines of Gadag gold field in the Hosur area, in northern Karnataka was carried out recently by the first author. Here, about 200 people are involved in ASM activity; 70 – 80 of them being women. It is broadly a family based practice where men enter the abandoned mines to collect the quartzose ore, while children help them in the crushing activities and the women are mostly involved in recovering the gold through panning and mercury amalgamation. Using a kerosene lamp for lighting the narrow openings through the reefs, they mine out

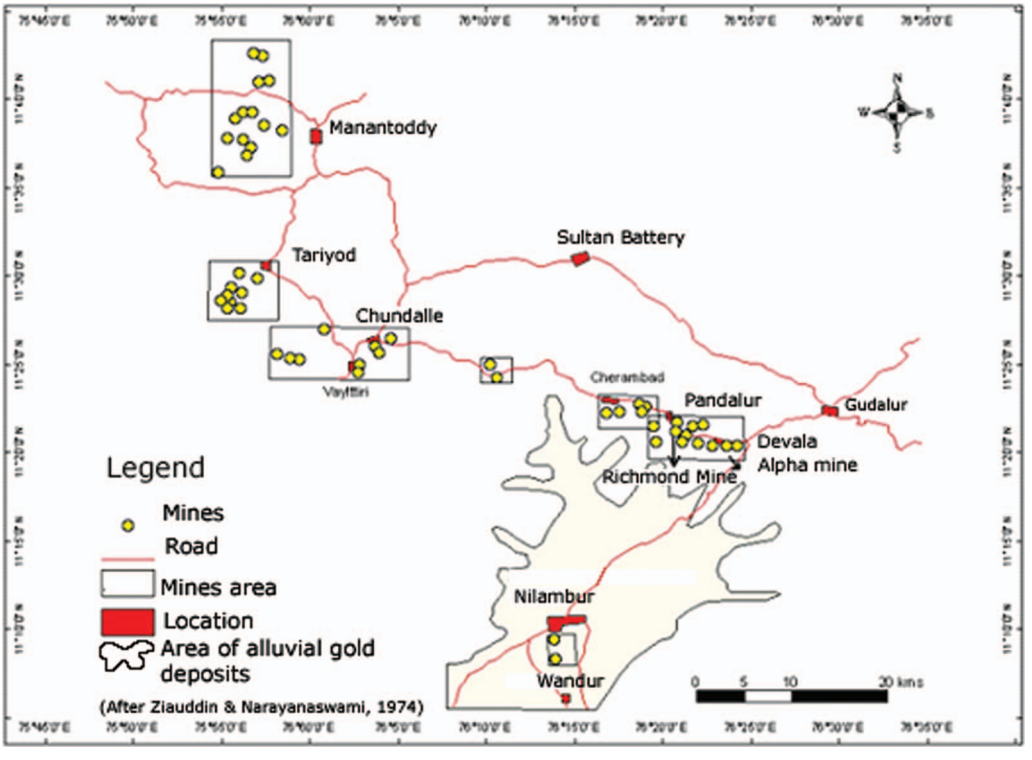

Figure 2. The location of erstwhile primary gold mines and alluvial mining tracts in Wynad gold field. Available in colour online.

(a)

(b)

Figure 3. (a) Adit in a primary gold reef near Pandalur, Tamil Nadu. (b) Fox Hole used for artisanal gold mining near Devala, Tamil Nadu.

Figure 4. Alluvial mining by indigenous communities in Nilambur region.

the quartzose ore with the help of chisel and hammer and bring it out as a head load. The ore is then crushed and panned under water (Figures 5(a) and (b)), when the gold separates into the fines from which it is recovered using a bead of mercury (Figure 6). The technique involves the adherence of the gold fines to the bead of mercury which is then broken into smaller pieces by hand and the portion containing the gold separated out from the rest. The portion of mercury without gold is recovered for reuse and kept in small vials. The portion with gold is then burnt to recover the fine bead of gold, releasing the mercury into the air.

The families earn between Rs. 300 and 500 weekly by selling about 2 g of gold to a gold merchant (sunar) who comes from the neighbouring Gadag town once a week. The villagers keep track of the market price of gold and its fluctuations through local newspapers which account for their variable earnings. These ASM miners have never received any aid from governmental or non- governmental agencies so far neither do they pay any royalty. They are unaware of any kind of health hazard due to handling of

(a)

(b)

Figure 5. (a) Crushing of ore by indigenous method of using a boulder. (b) Panning by women during ASM activity on primary gold ore in Hosur area, Karnataka.

Figure 6. Mercury bead in the hands of a panner, during the process of extraction of gold by amalgamation, Hosur area, Karnataka. Note the scar on the hand of the panner.

mercury for gold extraction and laugh at the mention of any such suggestion. While small accidents are a norm, major accidents are rare.

5.2. Tin

The distribution of the various tin prospects along with the major tin producing regions is shown in Figure 1. India has three official tin leases covering 65 hectares of land producing a steadily decreasing amount (from 39 thousand kg in 1998 – 1999 to 10 thousand in 2002 – 2003) [9]. The major tin deposits of the country are located within the Bastar region of Chattisgarh. These are of primary pegmatitic and alluvial type and hence are prone to artisanal mining. The other tin – tungsten prospects are in western India amongst which Tosham is the best known deposit in the Bhiwani District of Harayana.

In the south-western region two government agencies are engaged in producing tin from ore. These are Madhya Pradesh State Mining Corporation (MPSMC), Bhopal and Orissa Mining Corporation (OMC), Koraput. However the tin ore is actually mined in an artisanal way by the local indigenous populations from colluvial & alluvial deposits by manual digging and hand panning. Equipments used are minimal, and women again form a large section of the miners. The tin produced is purchased by these government agencies from the locals and shown in their production figures [11].

The cassiterite bearing colluvial placers are widespread in the areas covered by forests and the cultivated paddy fields. To win the ore, tribals resort to indiscriminate felling of trees resulting in widespread deforestation. In many places conventional agricultural practice has been given up by locals in favour of mining, hence neglecting the fertile lands. The by-products like muscovite, lepidolite, beryl, feldspar, quartz, etc. along with rare metal minerals which are costlier than tin metal are not being recovered from all these areas.

5.3. Coal

India produces a significant amount of coal every year ($\sim$350 million tons) making it the third largest coal producer in the world. The distribution of the major coal deposits in

India is shown in Figure 7. The figure shows that some of the major coal deposits of the country are in eastern India, lying within the states of Jharkhand and West Bengal. Assam and Meghalaya is another area with presence of coal deposits. Coal has been mined in India since the colonial times; the first coal was discovered in 1774 by two English administrators, Suetonius Grant Heatley and John Sumners, traveling along the Damodar river, when they saw local tribal communities burning this commodity for keeping themselves warm. It took a few more decades for a demand for local coal to pick up, and after the introduction of the railways and establishment of the jute industries along the Hooghly River near Calcutta, coal mining started full-scale in Raniganj and

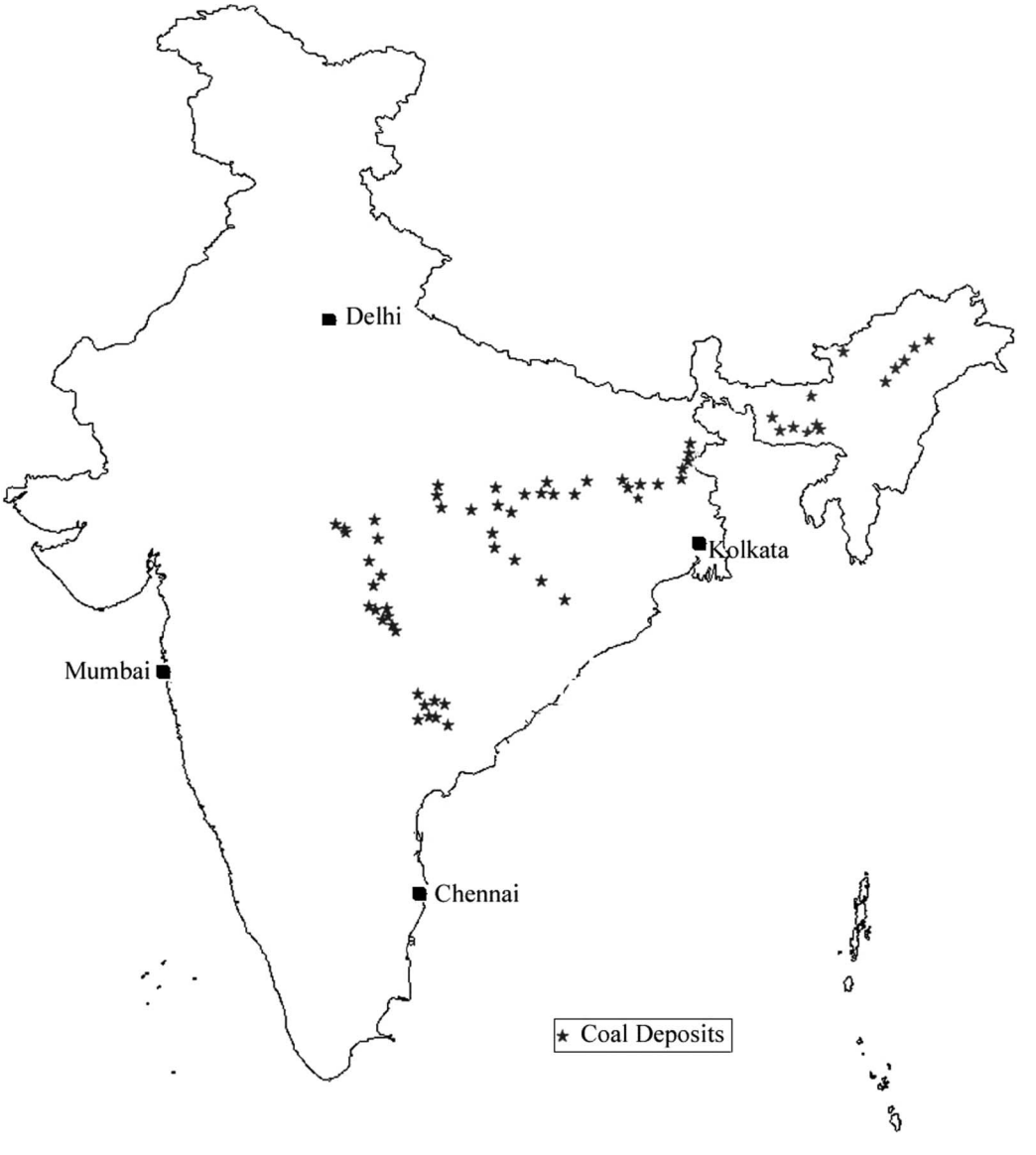

Figure 7. Location of major coal producing areas in India.

Jharia-Kargali fields in eastern India [12]. All the coal mines of the country were brought under national ownership in several phases during 1971 – 1973, and since then except for a handful of captive mines, privately owned mines do not exist. However, there are an innumerable number of small and illegal mining operations that have flourished in the last two decades or so. Therefore, the artisanal mining activities in coal are entirely illegal operations.

Eastern and northeastern India as a whole are amongst the lowest income states in the country. These states also face the problems related to cross-border migration from Bangladesh, Nepal and Bhutan along with insurgent activities. The rampant poverty in these states have forced the local population to resort to artisanal mining of coal, not only to earn their livelihood by selling the coal to small domestic and other consumers (such as sponge iron factories, tea stalls and brick kilns) locally but also to meet the family's fuel needs. Part of the production is even smuggled across the international border. The entire activity is illegal, as coal is a major mineral which only the government agencies can extract, and may be conducted in collusion with local administration and coal mining company officials. There are three main sources of artisanal coal: (1) small shallow village-dug mines (both open cut and tunneled, on both privately owned land or on village commons or *gair majurwa* or deedless land), (2) re-excavating abandoned or orphaned government mines (both underground and open cut), and (3) scavenged from officially operating mines or was otherwise pilfered from sale dumps[6]. The total amount of production from these sources is impressive. A recent conservative estimate put the figure transported on bicycles at 2.5 million tons [13]. Lawlessness, poverty and ignorance of safe mining methods have resulted in extensive environmental degradation in these coal mining regions, including land dereliction and extensive fires on the surface and in the coal seams [14,15].

A different type of coal and lignite mining occurs in the northeastern parts of India, especially in Meghalaya, which according to the Indian Constitution is quite different from the rest of the states. Here traditionally the indigenous communities have enjoyed the ownership of local natural resources. Consequently, they own the mineral resources under their privately owned land. A large number of diggings are prevalent in this part of the country, mostly under private ownership, but without a license as coal mining licenses can only be given to state-owned companies. The shafts are mostly inclined and shallow, and the labourers employed are primarily migrant Nepalese. In the fragile mountain ecosystem of the Himalayas, this mining is certainly harmful but it provides a major source of jobs and income to local people as well as the immigrants.

5.4. Gemstones

India has been well known for a variety of gemstones since time immemorial. Following the tradition, artisanal mining for gemstones in the colluvial and alluvial deposits in gravel beds and paleoplacer deposits has been active in various parts of the country. Gems being an easily marketable and valuable commodity, interferences of unscrupulous hands in gem prospecting and mining are common. Alluvial diamond is collected on an artisanal scale in many of the river beds in central and south India. Sporadic small occurrences of a few precious and semi-precious stones, viz., ruby, sapphire, emerald, corundum, aquamarine, heliodor, apatite, garnet, zircon, and idolite have been reported from a number of localities in Kalahandi, Sambalpur, Bolangir and Koraput districts of Orissa and in the adjacent Eastern Ghats belt of Andhra Pradesh [16]. Most gemstones occur as discrete grains in bedrocks and as erratic patches and pockets in soil, colluvium and gravels. They also occur as thin zones in the secondary profiles, not amenable to planned mining.

In the Eastern Ghats mobile belt in parts of Vizianagram, Vishakhapatanam and east Godavari districts of Andhra Pradesh, several blocks are known to be prospects of gemstones with some being mined illegally [17]. In Chintapalle block located in the reserve forest area, good quality yellowish green and peacock green chrysoberyl cat's eye and honey brown sillimanite cat's eye occur in several places viz., Meduru, Pinapadu, Poturajuganulu, Gurralagondi, Rintada & Satyavaram. Here gemstones are picked up from colluvium and soil or by illegal quarrying of weathered pegmatite up to depths of 10 – 15 m by making cross adits or inclined shafts. In Addatigala block 15 people died on one occasion during illegal mining activity in a quarry mining Alexondrite (variety of chrysoberyl cat's eye) in the Tapasikonda reserve forest. Extensive illegal mining by locals for the yellowish green chrysoberyl cat's eye have come from Araku Valley area in Visakhapatanum district.

In Tamil Nadu transparent varieties of corundum i.e. ruby and sapphire varieties, such as, blood red, oriental sapphire, oriental emerald along with chrysoberyl, zircon, topaz, etc. have been occasionally found around Kangeyam and Padiyur in Periyar district and in the Manavadi area, Karur district [18]. Ruby occurs in the paleo gravels/pebbles in Manavadi area. The local people here make rat holes to collect the gemstones after every rainfall. Gem quality feldspars are also being collected by selective mining of pegmatites in an unauthorized way, either in the form of digging wells or of pits by private parties. The local entrepreneurs locate hitherto known gem bearing tracts and exploit the resources illegally with the help of local villagers/labourers who earn only a pittance while the largest share of the booty is cornered by these middlemen.

6. Recommendations

As noted earlier, there is no legal status for artisanal mining in India, although these practices have been carried out over centuries. As of now, unlike many other countries (for example, in the Philippines, [19]) there is no clear-cut definition and distinction between artisanal and small-scale mining in India. As a result, no proper rules and regulations are in place, leading to difficulties in solving environmental and social problems associated with these types of mining activities. Even if there were rules, the scattered and seasonal nature of the mining would make it difficult to monitor and regulate these ASM activities. This is the primary reason for the lack of data and haphazard growth of this sector. Legally, except for fuel minerals (coal and lignite), all other minerals are open for small scale mining activities. Lack of available official or unofficial data related to the practice of artisanal mining in India makes the whole issue very nebulous. The lack of a database is also a great hindrance to policy makers. However, since a large number of people earn their livelihoods from these mining practices, they must not remain hidden and efforts should be made to regularize them and acknowledge their livelihood potential.

On the basis of the previous report, we can make *four* specific recommendations. The first is of course about the need to create a broader information base, including a database about the artisanal mining sites. The scientific as well as social data collated together from this database would eventually help policy and decision makers to organize this sector by means of strict rules and regulations. A small beginning in this regard has been made at the School of Environmental Studies, University of Delhi, by developing an ASM database software, under the CASM (Asia) programme.

The second recommendation is to locate the responsible body within the administration to deal with artisanal mining, given the neglect of higher state bodies. A possible agency that we could suggest is the local governments; in most places in India, the *Panchayats* are the

local representative bodies of the state. These bodies could be educated about artisanal mining and the issues thereof, their personnel strengthened, trained with the legal frameworks, and equipped with necessary powers to deal with the artisanal mining activities under their jurisdiction. Development of small scale experimental projects under the control of local *panchayats* for diamond mining in the alluvial tracts of Krishna, Godavari, Mahanadi and Pennar Rivers in southern India is one such possibility [20].

The third and strongest recommendation is to review the existing legal frameworks in the country relating to mining as a whole and artisanal mining specifically, and to make them more realistic, unambiguous and pro-poor. For this, some of the existing confusion over definitions may have to be clarified. The existing mining laws will have to be amended so that short term licenses can be granted, with the ASM miner becoming a partner in the scheme. Regularization of illegal ASM operations, instead of marginalizing them, will lead to improvement in lives of miners and their families and the concept of sustainability can begin to be introduced [21].

Lastly, we would suggest that the time has come, especially in view of the Millennium Development Goals of poverty eradication, to attack this area of concentrated poverty. Suitable education and training programmes should be taken up instead of turning a blind eye to this sector, for the miners and the administrators, with a view to improving the environmental performance of the artisanal miners and to reduce exploitation and poverty within the sector, which has the potentiality to provide employment to a large number of currently jobless rural youth.

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Notes

1. Kautilya's *Arthashastra* is the oldest written record of mining policies and practices of the time and it has been dated at 400 BC.
2. According to this Act, a 'mine' means any excavation where any operation for the purpose of searching for or obtaining minerals has been or is being carried out and includes many other specific activities and operations. 'Minerals' according to this Act means all substances which can be obtained from the earth by mining, digging, drilling, dredging, hydraulicing, quarrying or by any other operation and includes mineral oils which in turn include natural gas and petroleum.
3. Available from http://mines.nic.in/nmp.html, accessed by us on 16 December 2005.
4. This is a 'subordinate organization under the Department of Mines, Ministry of Mines and Minerals. It is engaged in the promotion, conservation and scientific development of all the mineral resources of the country, other than coal, petroleum and natural gas, atomic minerals and minor minerals' (Government of India, Department of Mines, Annual Report, 1999 – 2000, p.1 Available from http://mines.nic.in/archp4.html accessed on 12.14.2005).
5. Small scale Mines upto 0.1 mtpy, medium scale Mines upto 0.1 to 0.5 mtpy, large scale Mines over 0.5 mtpy.
6. Sale dumps are depots where the mining companies store their coal after digging it out from different collieries. These are also distribution points for legal coal. Therefore, these are spots from where trucks leave with 'linkage' papers to their destinations.

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