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Conflicts in the Use of Dune Sands in the Coastal Zone between the Kandaleru and Swarnamukhi Rivers of Nellore District, Andhra Pradesh, India

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Nellore dune sand deposits of high quality useful in glass and moulding industries, formed due to marine regression followed by intense wind action sometime during Pleistocene-Holocene Period, are mined extensively. There has been threat for mining owing to objections by farmers irrigating their lands with springs emanating from the dunes, while the recent establishment of Krishnapatnam Port in the vicinity has led to the cancellation of mining leases to promote industrial development. Apart from suggesting remedies to dissolve these conflicts, this paper points out on the need for the Indian Bureau of Mines and State Department of Mines and Geology to exercise caution in reporting data on mineral statistics of definitive nature without discrepancies.

As the occurrence of mineral deposits is location specific and cannot be shifted to any other place, Chandamouli et al. (2012) have made out a case to bring out a comprehensive legislation to ban mineral-rich areas from being used for some other purpose until the economic minerals in them are fully exploited and the land returned back in an environmentally fit condition for putting it to another use. The present paper deals with a balanced development of the coastal zone between Kandaleru and Swarnamukhi rivers of Nellore district (renamed recently as Sri Potti Sriramulu Nellore district or SPS Nellore district in southern Andhra Pradesh, India together with its abundant groundwater, silica sand deposits and high potential for development of port-based multipurpose industries under Special Economic Zones (SEZ).

The Nellore silica sand deposits are confined exclusively to the coastal zone between the Kandaleru and Swarnamukhi rivers in the Chillakur and Kota mandals in Nellore district essentially between North Latitudes 14°02' and 14°10' and East Longitudes 79°51' and 80°09' in the Survey of India topographic maps 57 N/16 and 66 C/1 on a scale of 1:50,000 (Fig. 1). The study area is well connected by air, rail, road and sea; and some decades ago through the Buckingham canal now under dilapidated condition. Gudur, the nearest town to the area on the South-Central Railway connecting Howrah and Chennai directly or via Renigunta, passes through the National Highway No. 5 connecting Kolkata and Chennai.

The present study indicated that the study area, which is more or less a level land, was submerged under seawater sometime in the Pleistocene to Holocene Period, characterised by long spells of global cooling (otherwise called glaciation) alternating with global warming. Studies along the coastal tract of the study area indicated that there was once rise of sea level owing to global warming leading to transgression (submergence) of some 20-km wide coastal land east of Gudur town under the sea. This was followed by lowering of sea level owing to global cooling leading to regression (exposure) of land to the present position with deposition of coastal sediments and dune sands of aeolian (wind) origin. The coastal sediments consist of sand, silt, clay and shell fragments in varying amounts with variable effective porosity to carry fresh to saline groundwater in varying amounts. The mineral grains of dunes under intense wind action, reworked during a number of sedimentary cycles, are almost wholly composed of quartz with remarkable uniformity in grain size and high roundness. These dune sands occur in the study area as crescent-shaped deposit occurring some 6 km west of the east coast measuring around 17 km in length, 2.5 km in breadth, 4250 ha in area and 12 m in depth in the study area (Fig. 2).
Use of Groundwater in Dunes for Irrigation:

The groundwater potential of dune sands is very high owing to high effective porosity, high hydraulic conductivity, high transmissibility and high storage capacity. Owing to absence of any soil cover and vegetation, the entire rain falling on them recharges groundwater with extreme ease with surplus discharging as gravity springs. Contrary to the general easterly flow of both surface and ground waters in the Kandaleru, Swarnamukhi and other rivers, the groundwater flow and spring discharge in the dunes is in a general west to northwest direction feeding Yeruru, Vellapalem and Chintavaram irrigation tanks in the west with surplus discharging into the Kandaleru River. Construction of 16 spring channels with an aggregate length of over 28 km in the dunes by the local farmers in the historic past has led to flow of spring water by gravity to irrigate 1698 ha of paddy round the year. There has been however need to renovate spring channels almost every year through efforts by farmers. Thus, except for a small area enjoying affluence through assured spring-channel irrigation round the year, the study area remained otherwise backward with no visible employment opportunities other than fishing, salt manufacture and forestry.

Use of Dunes for Mining Silica Sand:

It is found that the quality of dune sands is high with chemical composition approaching pure silicon dioxide for economic use. Apart from use in the manufacture of glass, it has a variety of uses such as making moulds and cast for metal foundries, as abrasive mineral, locomotive industries, furnaces etc. There are 66 mining leases of silica sand in an area of 918 ha in Addepalli, Ballavaram, Chintavaram, East Kanupur, Momidi, Ponuguntapalem, Thamminapatnam, Varagali, Vellapalem and Yeruru villages in Chillakur mandal, of which only six mining leases in an area of about 90 ha got expired. In addition, there are 13 mining leases spread over an area of 434 ha in Karlapudi, Kothapatnam and Siddavaram villages in Kota mandal. As these silica sands are exposed at surface without any overburden of waste material, they could be simply excavated manually by contract labour for loading in lorries for sale mostly as raw silica sand to Chennai, Bangalore and other places (Fig. 3). Because of ease of mining and good demand, more than 80% of mines have valid mining leases recording some production or other.
Exploration and exploitation of Nellore silica sand is rather easy owing to its occurrence at surface without any overburden with scope to determine its quality and reserves with ease. The methods of mining of silica sand adopted however are such that it is difficult to mine once the water table is reached (Fig. 4). Because of high groundwater yield, the water table cannot be also lowered by pumping. It is not uncommon to find accidental drowning of animals and human beings in the idle mines.

**Fig. 2:** Geographical Distribution of Dune sands in the Study Area. Eighteen spring channels flow from east to west to northwest.

Silica sand mines can be identified best in the high-resolution Google Earth satellite images from their characteristic grid pattern with alternating bands of sand (white) and the exposed groundwater in mined portions (black) (Figs. 5 and 6). The silica sand deposits of the study area can be compared with the silica sand deposits of Langholme sand quarry in Humberside of United Kingdom (IBM, 1993). Most of the silica sand in this quarry occurs to a depth of 10 m, while the water table lies at a depth of one metre from the ground level. Mining of silica sand could not be taken up for several years owing to difficulty to lower the groundwater table despite heavy pumping. With the taking over of the mine by P.R. Sand Limited, silica sand mining could be resumed by using a suction cutter dredge having a capacity of about 60 tonnes per hour that can operate to a depth of 10 m. The dredged sand was then fed to a 3-mm trash screen and transferred to a Floatex classifier to obtain sand of the requisite size ranges. A similar method could be adopted in the study area for effective mining.
It is noted that there is no other area in Nellore district carrying silica sand deposits. Although silica sand mines exist in parts of Kurnool and Prakasam districts, Nellore silica sand accounts for around 99% of the entire state’s production. Of the 2.55 million tonnes of silica sand produced in the country in 2009-10, the contribution by Andhra Pradesh is the highest at 38%, while Gujarat produces 18%, Rajasthan 16%, Maharashtra 11%, Uttar Pradesh 7%, Karnataka and Jharkhand 4% each, and Kerala 1% (IBM, 2011a). A washed and graded silica sand unit has been established by the Mangalore Minerals Pvt. Ltd. with a capacity of 0.5 million tonnes per annum at Momidi in Chillakur mandal.

The year-wise production of Nellore silica sand from 2000-01 to 2010-11 as collected at the Office of the Assistant Director of Mines Geology, Nellore ranges from 0.39 million tonnes in 2001-02 to 1.91 million tonnes in 2010-11 with a mean of 0.97 thousand tonnes (Fig. 7). In contrast, the production of Nellore silica sand as reported by the Indian Bureau of Mines is consistently lower. For example, IBM (2011b) reports production of Nellore silica sand in 2009-10 to be 948 thousand tonnes as against 1.5 million tonnes reported by the State Department of Mines and Geology. Thus the figure arrived at by the IBM is 63% of the figure of the State Department of Mines and Minerals. In the interest of people to have faith in the data furnished by the Government Departments, there is need for the sister Government Departments to report data of definitive nature without discrepancies.

Another point of concern relates to the high variation in the cost of silica sand prevailing in different states (IBM, 2011a) (Fig. 8). The prevailing cost of silica sand in Andhra Pradesh, which has the highest demand owing to its best quality, is the lowest at Rs. 67 per tonne in Andhra Pradesh while the cost of Kerala is the highest at Rs. 593 per tonne. The average cost of silica sand for the country as a whole is at Rs. 160 per tonne, with the average cost in the private sector at Rs. 155 per tonne and the public sector at Rs. 279 per tonne. This anomaly is because of the prevailing Acts and Rules passed by the Central Government, as per which the State Governments are empowered only to collect royalties as per the value of the mineral mined at the pithead (i.e., ad valorem basis) rather than linking it with any international benchmark price.
(IBM, 2011a). The low royalty of the Nellore silica sand is because of the extreme ease with which the mineral could be mined. There is need to revise this rule and make the royalty to have a bearing on the international benchmark rather than on the pithead price for the Government to realise maximum revenue.

**Fig. 4:** A view of a silica sand mine showing high-quality silica sand with groundwater occurring in sand at shallow depth. The present mining method does not allow mining once water table is met.

**Fig. 5:** A Google Earth image captured by GeoEye satellite on 29 Apr 2000 showing spring channels, silica sand mines and irrigated land with silica sand mines showing the characteristic grid structure. A washed and graded silica sand unit of the Mangalore Minerals Pvt. Ltd is seen at Momidi, Chillakur mandal.
Fig. 6: A Google Earth image captured by GeoEye satellite on 19 Oct 2009 showing spring channels, silica sand mines and irrigated land with silica sand mines showing the characteristic grid structure east of Ballavolu in Chillakur mandal.

Fig. 7: Year-wise Production of Silica Sand in Thousand Metric Tonnes in the Study Area from 2000-01 to 2010-11 and average production as per the Assistant Director of Mines and Geology, Nellore.
Fig. 8: State-wise prevailing cost of silica sand in Rupees per tonne as in 2009-10 (After IBM, 2011b) with Andhra Pradesh recording the lowest price.

Conflicts between Users of Groundwater and Users of Silica Sand:

There has been conflict between the local farmers and the silica sand mine owners with the former opposing mining on the ground that mining depletes water required for irrigation on which they have riparian rights. The supporters of mining on the other hand argue that it is not justified to prevent silica sand of high economic value that has spread over an area of 4250 ha just to irrigate 1698 ha of cultivated land. If mining is prevented, the industries using this silica sand have to import it at high cost involving use of foreign exchange. The authors’ studies have indicated that the quantum of groundwater available in the dune sands is much more than the water required for irrigation of the existing command area. It is further noted that the area leased out for silica sand mining is just 1452 ha, which accounts for just 34% of the total surface area of 4250 ha occupied by the dunes. Apart from this, there is now no conflict between the farmers and mine owners owing to the State Government earmarking a share in the Kandaleru-Poondi canal meant for supplying Krishna river water to convey drinking water to the city of Chennai.

Conflicts between Land Use for Mining and Setup of Industries:

With the formation of the Krishnapatnam Port Company Limited (KPCL) which got the mandate of the State Government to develop the previous minor port into modern, deep water and high productivity port, on BOST (Build–Operate-Share-Transfer) concession basis for 50 years, the Kandaluru mouth was dredged and modified as Krishnapatnam Port with four berths for ships constructed on the left bank of the estuary (Chandra Mouli et al., 2012). Groins were constructed to extend into the Bay of Bengal with right bund extending to a distance of 1500 m and left bund to 750 m to prevent sedimentation. With numerous strengths including its area, location, good weather and new generation world class port facilities, it is soon going to become one of the biggest ports in the world and the largest port in India. It has largest port-based storage area, multiple cargo handling facilities, superior connectivity, good weather for round the
clock operation throughout the year and infrastructure and logistic set up of international
calibre. With this, there has been a steep demand for land on either side of the river to establish
port-based multipurpose industries under a Special Economic Zone (SEZ). As a part of a drive to
find out land for the purpose, the State Industries Department has chosen to cancel all the
mining leases of silica sand in Nellore District. This decision was contrary to several earlier
orders of the Industries and Commerce Department banning allotment of lands having mineral
wealth for any purpose other than mining. Both the Federation of Indian Mineral Industries
(FIMI) and the Institute of Indian Foundrymen opposed vehemently for cancellation of mining
leases in lands having valuable silica sand deposits. Finally, with the intervention of courts, the
mine owners could safeguard their leaseholds temporarily for continuing mining.

The authors’ work has indicated the existence of large contiguous areas in the vicinity of
mines, which are devoid of silica sand deposits and also do not support any vegetation now or in
future. Such lands could be best acquired for allotment to SEZ without the need to cancel any of
the mining leases of silica sand.

Suggested Reading:

practices in the Narji limestone belt in YSR district, Andhra Pradesh (AP), India: Open Access e-

changes in the position of mouths of Arani river and Pulicat lake with the Bay of Bengal in
Tiruvallur district, Tamil Nadu, India: Open Access e-Journal Earth Science India, Popular

Division, Indian Bureau of Mines, Nagpur, 96 p.


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