CRITICAL EVALUATION OF INLAND CORAL MINING IN THE AKURALA - RATHGAMA AREA

by

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1.0 Introduction

Coral limestone deposits exist at various locations along the coastal belt of Sri Lanka from Ambalangoda to Matara. These deposits are also found overlying the Miocene limestone in Jaffna Peninsula, Kalkudah, Kuchchaveli and Delft Island. Inland coral deposits occur as patches and lenses and the thickness of these deposits is highly variable from place to place. Coral reefs are notably exposed from Akurala to Hikkaduwa. Off-shore coral mining is the major cause of coastal erosion. The damage caused to coral reefs by off-shore coral mining has an effect on the cost-reef ecosystem. Although this activity has now been banned by the Government, illicit coral mining cannot be totally eliminated by enforcing laws alone.

The coral limestone is of great importance as a raw material for the lime industry along the coastal belt from Ambalangoda to Matara. Therefore, inland coral mining has to be accelerated due to the escalation of the demand for lime in the building and construction industry. A survey undertaken by the Geological Survey Department of Sri Lanka in 1985, gave a figure of 48000 tons of coral limestone mined per annum, which produced 26000 tons of lime in South-Western and Southern coastal areas. The survey also identified 303 lime kilns from Akurala to Hambantota [3,6].

On the one hand the manual coral mining provides significant employment to the local population, but on the other hand this industry is now stagnant and, cannot cope with the growing demand for lime based products in the country. Furthermore, the available coral limestone reserves are being extracted manually in a wasteful manner. This haphazard coral mining will not only deteriorate socio-economic standards of the local population, but also endanger the environment. Therefore, the existing manual coral mining has to be evaluated and possible technological alternatives should be implemented for the betterment of lime based industries and the environment.

2.0 Area of Study

The study has been confined to inland coral mining in Akurala-Rathgama area. This area has been selected for the following reasons :

1. Coral deposits are highly developed in some places where they occur as much as 7 m. in thickness and cover as much as 600 m^2 in area.

11. **Coral mining continues to be the predominant industry among the local population, and a number of people are involved in the production of lime as an established cottage industry.**

111. Almost 100% of mined-out pits in the area have not been backfilled and subsequently these unfilled pits remain water logged. Consequently, these areas become ideal breeding grounds for mosquitoes causing environmental and health hazards.

3.0 Objectives of the Study

I. To devise a new mining method which facilitates the increase in the productivity of inland coral mining and the maximum utilization of inland coral deposits.

II. To devise a scheme to provide the coral miners with assistance and facilities required for the mechanized mining.

III. To devise a scheme to derive benefits from mined - out areas minimizing environmental and health hazards.

4.0 Description of the Existing Mining Method

4.1 General Situation

The coral extraction is solely a manual operation. The exploration of the coral deposit is carried out with a

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sharpened edge steel rod of 11 feet long and half a inch in diameter. It is called "Illam kura" and, forced into the earth till it reaches the deposit. The deposit is sensed merely by the experience of the miner.

Once the deposit is located the coral extraction is carried out by digging pits in the deposit. One pit is 10-12 m in length ; 7-10 m in width ; 5-9 m in depth. Three such pits would normally be accommodated in one coral lens (patch).

The output of a pit is of about 2 bullock carts (approx. 750 kg.) per day. Normally, 15000-18000 kg of coral limestone can be extracted before the liquidation of the pit. 10-12 workers are employed in one pit and the wage of a male worker is Rs.150 per day whereas a female worker is paid Rs.120 per day. The manual coral limestone production is a very costly process and the cost of production comes around Rs.30-40 for 25 kg of corals (Rs. 1200-1600 per metric ton).

4.2 Stripping Operations

Before commencing mining operations clay,silty and sand formations overlying the coral limestone have to be removed completely. The overburden is removed using pick - axes , iron - bars,shovels and semi - spherical steel baskets (plate 1).In some pits timber is used to support unstable overburden pit - walls. The instability of the pit - walls is caused mainly by the inflow of underground water so the pit has to be continuously dewatered (plate 1).

The overburden and waste removed from the pits are dumped into previously excavated pits.This material is highly insufficient to backfill the previous pits . As a result these areas subsequently become water logged creating breeding grounds for mosquitoes.

4.3 Mining Operations

Once the coral deposit is exposed within the limits, coral is extracted in the same way as the overburden is removed (plate 1). Loosened coral is lifted to the surface in steel baskets and then washed to get rid of clay, sand and silty matter.

Washed coral is then stockpiled to be processed in kilns. Caving occurs in most of the pits due to maintaining a 900 pit-wall angle without leaving a single safety berm.

Once the corals are mined out in one pit, the subsequent pit is advanced close to the previous one leaving an undisturbed strip of 1-0.5 m between them. The water inflow is a serious problem in pits. The dewatering of the pits is done in every 15-20 minutes.

5.0 Factors Affecting the Choice of a Mech anized Mining Method in the Area of Study

5.1 Geological Factors

Inland coral deposits in the Akurala-Rathgama area are nearly horizontal and consist of loosely-packed finger corals or stick corals. Heavy blocks of massive corals are often found overlying the finger corals. Acropora is the dominant coral type found in this area [3,6].

The average thickness of the coral deposits is about 4-5 m. And the average area is about 400-500 m2 in some places the lateral extent is as much as 30 m. Sand, clay and silty materials are found overlying coral deposits and the thickness of the overburden, varies from a few centimeters to about 1-2 m.

5.2 Hydrological Factors

The ground water flow rate in pits is so high that continuous dewatering of the pits is an essential operation during the mining of coral limestone.

5.3 Economic Factors

Although the coral mining is labour intensive, this activity has been widespread and popular in the study area due to the following reasons ;

(a) availability of considerable coral limestone reserves

(b) availability of cheap labor

(c) easy access to deposits

(d) requirement of small initial capital

(e) low royalty and taxes involved

5.4 Environmental Factors

The environment of the area and the health condition of the local population are demonstrably linked to mined-out pits.

6.0 Proposed Mining Method

6.1 General Idea

Manual coral mining activities have to be replaced with an appropriate mechanized mining method in order to increase the productivity and, to reduce the cost of production. In this context, the selected mining method should be socially acceptable; economically viable; and, environmentally sustainable. Furthermore, ultimate pit limits should

be chosen in such a way that one open pit consists of several coral patches (lenses). This arrangement will lead to extraction of coral deposits using surface mining equipment.

6.2 Stripping Operations

As the overburden contains unconsolidated materials it can be removed with the bulldozer-excavator (or loader)-truck (0r tractor trailer) technological combination or scraper-bulldozer technological combination. If the haulage distance of the overburden does not exceed 600-700 m, the scraper-bulldozer application would be a better choice as this application has its prominent advantages in loading and hauling of rock within the range of 1 km [15]. The scraper-bulldozer combination will also facilitate maintenance of the overburden bench slope as low as possible (fig. 1, fig. 2). The removed overburden can be used to backfill abandoned unplanned pits in the vicinity of the new open-pit, thus minimizing man-made mosquito habitats to a certain extent (fig. 1)

6.3 Mining Operations

As deposits consist of loosely-packed finger corals or stick corals, there is no need to carry out drilling and blasting operations and the coral deposits can easily be loosened by ripping alone. In this context, ripper-bulldozers or ripper-tractors can be employed to loosen the corals (fig. 1, fig. 2).

The loosened corals can then be loaded into tractor trailers or into trucks with front-end loaders and transported to stock-piles. As the maneuverability of front-end loaders are higher than that of excavators, it is prudent to employ front-end loaders alone in loosened coral handling (fig. 1, fig. 2).

The employment of front-end loaders enables the introduction of two coral limestone benches wherever the thickness of coral deposits exceeds 4 m. This would lead to an increase in the working face area and a decrease in the working pit slope facilitating stability of the pit walls and the expected productivity of the coral mining.

It is pointed out that coral deposits exist as patches and lenses. Therefore, in the process of coral mining, barren rock within pit limits could be left alone in the form of pillars (fig. 1). This suggestion is analogous to the underground room-and-pillar mining and would reduce the cost of production.

Optional technological combinations to implement the proposed mining method are as follows :

Table 1. Optional technological combinations in terms of equipment

Type of Operation	Option	Equipment	Approximate Number of Units	Capacity
Removal of overburden	1	Bulldozer	1	2.5-3.0 m^3
		Excavator	1	0.5-0.6 m^3
		Truck or Tractor-Trailer	2	3.0-3.2 m.t.
	2	Bulldozer	1	2.5-3.0 m^3
		Front-end-Loader	1	1.0-1.2 m^3
		Truck or Tractor Trailer	2	3.0-3.2 m.t.
	3	Bulldozer	1	2.5-3.0 m^3
		Scraper	1	7.0-9.0 m^3
Coral extraction	1	Ripper-Bulldozer or Ripper-Tractor	2	(ripping depth=500-700mm)
		Excavator	2	0.8-1.0 m^3
		Truck or Tractor-Trailer	3	3.0-3.5 m.t.
	2	Ripper-Bulldozer or Ripper-Tractor	2	(ripping depth=500-700mm)
		Front-end-Loader	2	1.2-1.5 m^3
		Truck or Tractor-Trailer	3	3.0-3.5 m.t.

6.4 Consequences of Mechanization and Solutions

The implementation of the mechanized mining will invariably give rise to the following major issues ;

I. Coral miners cannot afford the capital required for mechanization.

II. Mechanization cuts down the labour force creating unemployment.

As to finding a solution for the capital required to carry out mechanized mining, the following scheme could be adopted.

Formation of co-operative societies under the patronage of relevant state organizations or financial institutions to deal with coral based industries. These societies could not only provide the coral miners with necessary machinery and technical assistance, but also handle purchasing and marketing of coral limestone as well as other managerial functions related to the coral mines and coral based industries.

Concerning surface mining equipment, arrangements could be made to grant low-interest loans or to supply machinery on a lease/ hire basis. The leasing / hiring option seems to be the most suitable and, in this way the coral miners could lease or hire required equipment from the co-operative society at a nominal rate.

As for the unemployment, the mined out pits could be utilized to generate new sources of income to the workers who would become unemployed due to mechanization. The major benefit that could be derived from the mined-out coral limestone pits is the breeding of inland fish and prawns. Inland fisheries could be considered as a viable economic benefit and, could be introduced without any difficulty as it had one time been practiced to some extent in the study area. (It was banned giving lame justification.) Inland fisheries and related activities would provide significant employment adequately compensating for the loss of means of living due to mechanization. In addition to that,. fish breeding in the mined-out pits will help control mosquito-borne diseases in the area as mosquito larvae are consumed by fish.

7.0 Concluding Remarks and Recommendations

Amelioration of the inland coral mining in the Rathgama-Akurala area by a suitable mechanized mining method is essential and, this will invariably increase the productivity and the efficiency of the inland coral mining while reducing the cost of production to a large extent (the cost of production could be expected to be reduced to Rs.200-400 per metric ton). It is imperative that arrangements be made for the coral miners to obtain required financial and technical assistance for mechanized mining. It is also necessary to generate alternative employment to the workers who become unemployed due to mechanization, utilizing mined out pits. These measures would subsequently discourage the illicit off-shore coral mining to a large extent.

The following recommendations can be made :

(a) Select ultimate pit limits comprising five or six coral limestone patches (the length and width of a planned pit would be around 300 m and 200 m respectively). This enables simultaneous mining of several coral deposits with surface mining equipment.

(b) Employ the scraper-bulldozer technological combination to carry out stripping operations.

(c) Backfill abandoned unplanned pit in the vicinity of the new planned open-pit using removed overburden from the planned one. This would minimize man-made mosquito habitats to a certain extent.

(d) Employ ripper-bulldozers or ripper-tractors and front-end-loaders to carry out the extraction of coral limestone and to maintain two coral limestone benches wherever the thickness of coral deposits exceeds 4 m. This facilitates the achievement of the planned production target.

(e) Leave barren rock within pit limits alone in the form of pillars. This enables a considerable reduction in operating costs.

(f) Form co-operative societies of coral based industries under the patronage of relevant state organizations / financial institutions to provide the coral miners with adequate assistance and facilities required for the mechanized mining. At this juncture, the Southern Provincial Council has to play the key role.

(g) Launch a project to commence inland fisheries in the mined-out pits. This would generate new employment opportunities adequately compensating the workers whose livelihood would be affected due to mechanized mining. In addition, this project would minimize the mosquito menace and mosquito-borne diseases in the study area.

8.0 Acknowledgement

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9.0 References

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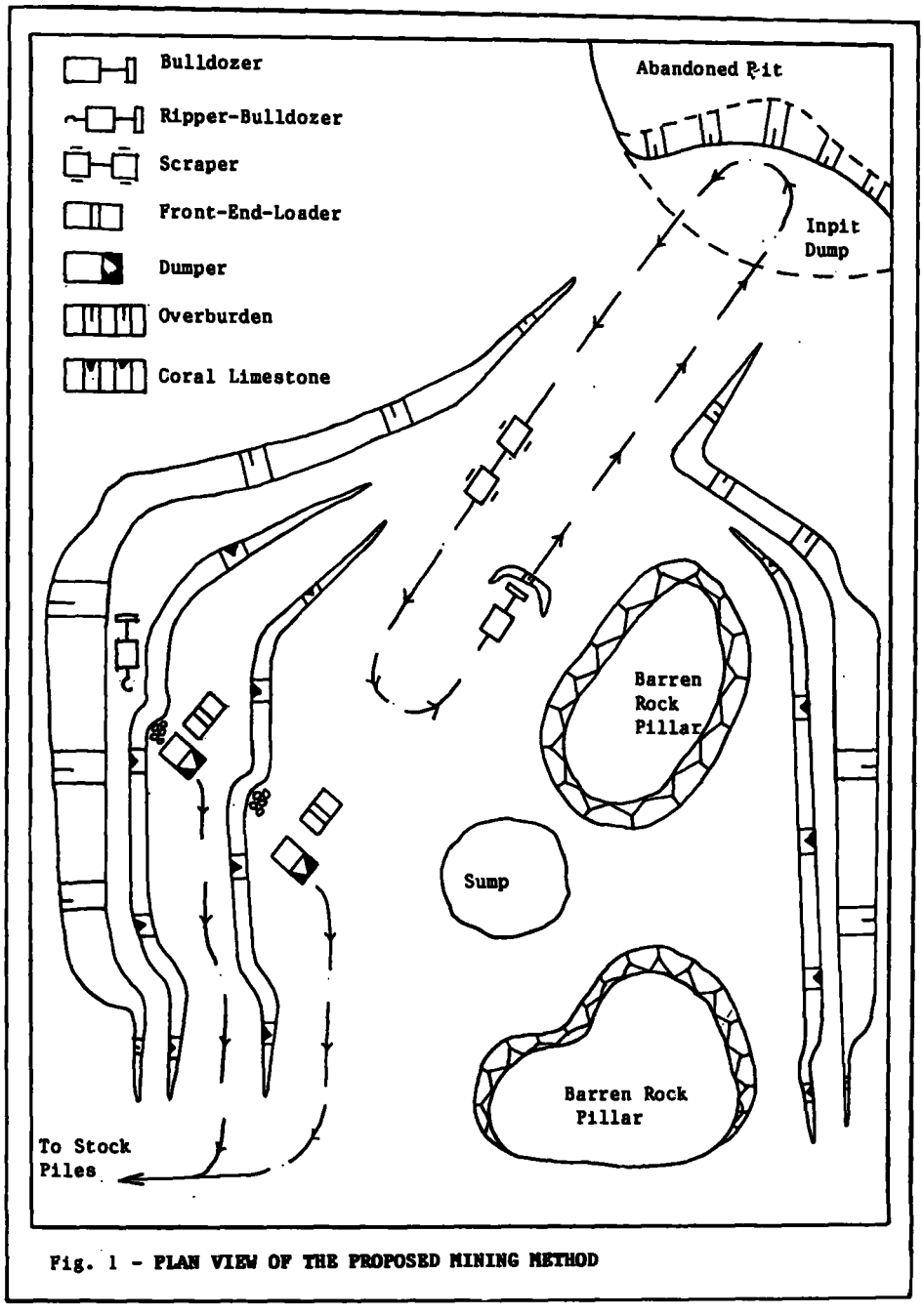

Fig. 1 - PLAN VIEW OF THE PROPOSED MINING METHOD

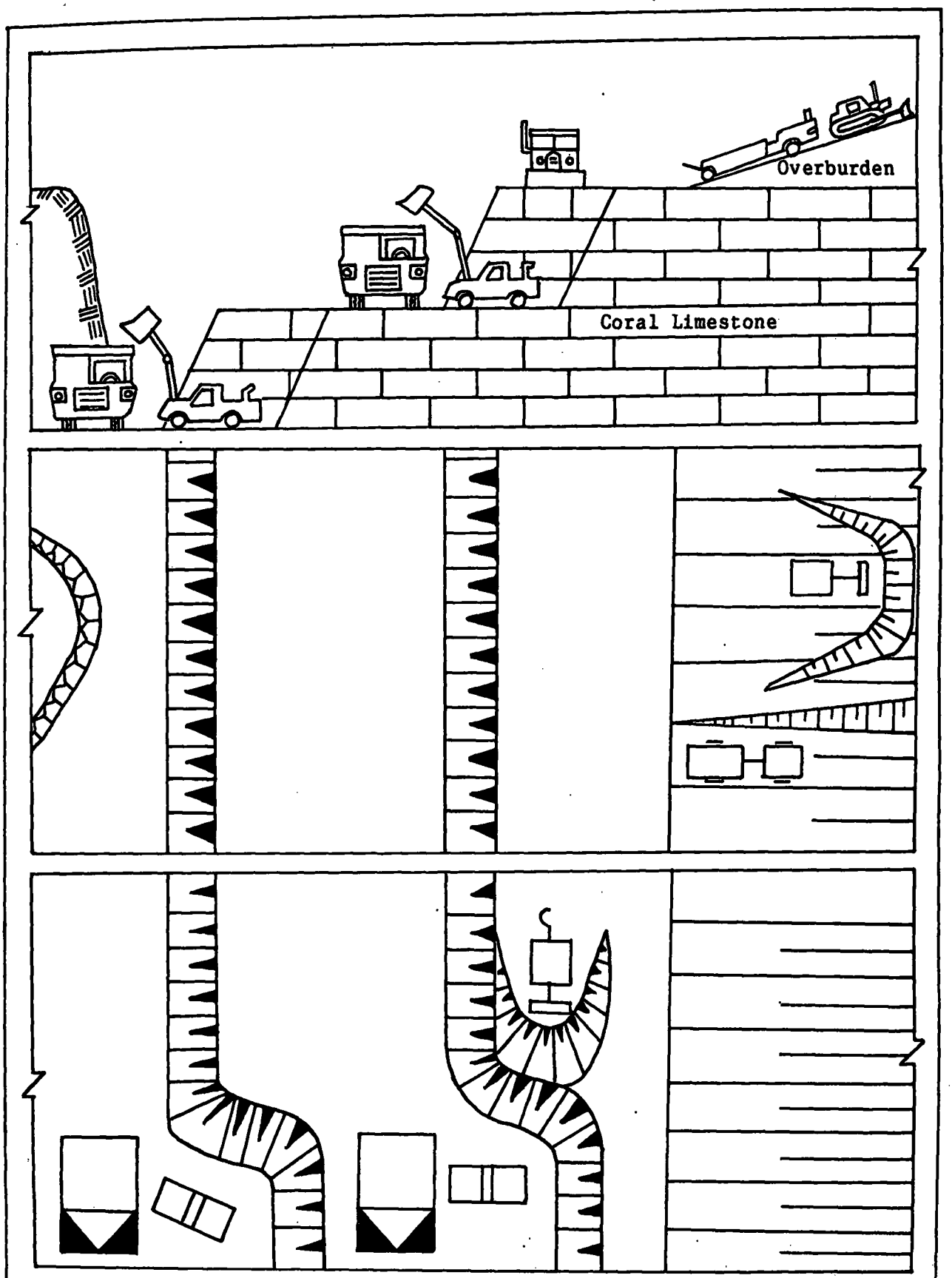

Fig. 2 - PROPOSED MINING METHOD (SECTION & PLAN)