38.

EVALUATION OF THE EXPORT TRADE IN MINERAL RESOURCES OF SRI LANKA; COMPARISON WITH THE ENVIRONMENTAL IMPACTS ON SOIL BIODIVERSITY

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ABSTRACT

Many varieties of minerals in Sri Lanka are exported in mineral export trade, posing a serious environmental issue. Despite the environmental problems, previous attempts to analyze the aspects of foreign exchange earnings against the exported quantities of minerals in Sri Lanka are scanty. Therefore, the present study was intended to analyze and evaluate the trade of minerals in Sri Lanka, with a particular focus on foreign exchange earnings of those minerals compared with the environmental impacts.

Data on the mineral exported were extracted from the Customs declaration forms (CUSDECS/Customs 53) submitted by mineral exporters at the Exports office, under the Department of Customs, during the period from 01 Jan 2000 – 31 June 2013. The data were also extracted from the published data of Customs statistical branch, Automated Data Processing Division of Customs, detection data bases of Central Investigation Division and Biodiversity Protection Division of Customs and from Central Bank annual reports. Data on environmental impacts were gathered following standard evidence-based protocols that included searching the primary literature, field visits, personal communication, personal observations to meet the objectives.

During the thirteen year period of 1st January 2000 to 31st June, 2013, total of minerals exported under seventeen commodity codes were collected. The exported minerals are natural Graphite, Quartz, Mica, Ilmanite, Rutile, Granite, natural sand, Kaolin, other clay, natural Corundum, pumic stone, pebbles and gravels, Dolomite, Feldspar, Zirconium, Zirconium ores &concentrates, Vanadium, lime powder, calcium carbonates, articles of stone etc. Total income generated out of mineral exports is 32.9 million US$ in 2011 and 61.3 million US$ in 2012. Minerals are exported from Sri Lanka to 48 countries. China, Japan, Germany, Italy, India, Malaysia, S. Korea, Singapore, Taiwan, UK and USA, are the leading importers of minerals from Sri Lanka.

Mineral exports consist of 1% of the total export commodities from Sri Lanka in 2012. When considering the total quantities of exported minerals during the thirteen year period, the biggest commodity is Ilmanite. Quartz and Rutile follow that. Natural Graphite, Mica and Granite have also been exported in a regular manner during the thirteen year period.

INTRODUCTION

The extent of Sri Lanka is 65,610 km^2, and, based on relief, it consists of three main peneplains; a lowland (up to 300m mean sea level (MSL)), upland (300-900m MSL) and highland (> 900m MSL). The lowland is extremely wide in the north and east, and has several isolated *inselbergs* rising above it, some over 300m in elevation. A marked escarpment, conspicuous in the east and south, separates this lowland plain from the middle upland plain. The highest parts of the Central Hill Country are made up of basins, plateaus, massifs and ridges. The highest peak in the island is 2524m MSL and several peaks rise to heights of over 2000 m, Cooray *et al.*, (2000).

Sri Lanka has formed part of Gondwanaland in the distant geological past, and it was never fully submerged by the sea. The only major marine transgression was in Tertiary times when Miocene sediments were laid down in the North-western belt of the island, including the Jaffna Peninsula. As a result, nearly 90 percent of

the area of the island is not covered by any sedimentary rocks. Precambrian rocks consist predominantly of a sedimentary succession of a variety of metamorphosed sedimentary rocks of two groups, Highland Complex, and the Vijayan and Wanni Complexes. Miocene formations cover large areas in the northwest and in the Jaffna Peninsula, Cooray, (1984).

Among the superficial deposits of recent origin in many parts of the country are alluvial on the river floodplains and loose unconsolidated sands in the coastal belts. These superficial deposits are economically important in agriculture and also in mineral industry Most important minerals are gemstones, heavy mineral sand, Graphite, Ilmanite, rock phosphate, Quarts, Dolomite, industrial clays etc. which have high potential commercial value for exports.

Soil is the matrix of terrestrial ecosystem and it is produced as a result of degeneration the minerals. Therefore mineral resources are the basis of soil ecosystem. Mineral resources are mining from the soil and rocks for export trade as well as for local use. Export trade of mineral resources is depending on excavation and mining activities. Due to the above factor unsustainable utilization of mineral resources may affect the biodiversity including entire ecosystem. Soil-biodiversity is the most affected environmental component in the process of excavation, extracting and processing of those minerals for local use and export purposes.

Mining of minerals, being an environmentally unfriendly activity, and the effects are multifaceted, Saxena (2001). The environmental effects in gemstone mining is well reported in the aspects of water (contamination of rivers, lakes and groundwater, alteration of surface and groundwater flow); soil (erosion and instability, loss of soil, material contamination , improper sanitation; air (increased dust);fauna &flora (loss of habitat, overuse of timber resources, increase poaching; humans (contamination of drinking water, land rendered infertile for agriculture, safety hazard pits during and after mining, relocation of populations adverse environmental health conditions, land-use conflicts), landscape destruction *etc.*(Hilson2002,MaCfarlane *et al,*2003,Cardiff 2007,)Cartier,(2010).

Among those effects of social impacts are displacement of the people, loss of livelihood, changes in population dynamics, cost of living, water scarcity, noise and vibration, health impacts, infrastructure facilities,, self employment opportunities, increase in aspirations, addictions, economic disparity and frustration ,Saxena (2001). Stream ecosystems, and hence, their invertebrate communities have been significantly affected by human exploitation of the land. Among these uses the extraction of forest and mineral resources resulted in long-term and often highly destructive modification of the environment, Harding *et al.*(2000).

Sludge from mining exploitation can be a source of land and water contamination in the adjacent zone. The change in mobility and therefore in toxicity can occur at short or long term after exposure of sludge at environmental conditions Lacal *et al.* (2003).

The important natural controls, such as climate, and anthropogenic activities such as mining and mineral processing methods mostly modify the environmental effects controlled by mineral deposit geology and geochemical process. These environmental alterations could be deposit size, host rocks which the ground water hydrology depends, surrounding geologic terrene, wall-rock alterations which strongly affect environmental signatures, nature of ore, deposit trace element geochemistry, mineral characteristics, secondary mineralogy, topography and physiography affect the position and shape of ground water table, Edward (1995), Danielopol *et al.* (2003).

Magnitude of soil erosion losses within the larger resources basis of the economy, Cohen *et al. (2006*). Different types of chemical and physical impacts associated with diverse mining and mineral processing operations, Ashton *et al.* (2001).These environmental impacts are economic, technical, legal and operational in nature, Benjamin *et al.* (2002).

OBJECTIVES

The present study was intended to analyze and evaluate the export trade of mineral resources with a particular focus on the following areas:

1. Determine the exported varieties, and their trade quantities in Sri Lanka.
2. Evaluate the actual foreign exchange earnings from the export trade of mineral resources.
3. Propose a suitable way forward to address the revenue related to export trade of mineral resources in Sri Lanka.
4. Address the environmental impacts in excavation and mining the mineral resources.

METHODOLOGY

The research was carried out in Sri Lanka Customs from 01 June 2013 to 31 July 2013. The following sections elaborate the methodology adopted to gather relevant data in order to achieve the objectives of this survey.

Data on the mineral exported were extracted from the Customs declaration forms (CUSDECS/Customs 53) submitted by mineral exporters at the Exports office, Customs head quarters, under the Department of Customs, during the period from 01 Jan 2000 – 31 June 2013. The invoice, packing list attached to the Warrant / Security copy of the CUSDECS were sorted under the commodity codes, which are the international Customs code for minerals. The data also extracted from the published data of Customs statistical branch, from Automated Data Processing Division of Customs, Detection data bases of Customs Investigation Division and Biodiversity Protection Division of Customs and Central Bank annual reports. The export permits issued by the Director, Geological Survey and Mines Bureau to export certain minerals were also evaluated to determine exported quantities. The data on export of minerals were entered manually on an Excel spreadsheet, under the following information categories: Date of entry; CUSDEC No.; Exporter's Name; mineral species; Quantity; Value; Destination and Availability of permits. The export quantities of each species were tabulated on a monthly basis, for the years from January 2000 to June 2013. In addition, information on international market prices was also extracted from the relevant websites. In the case of different data (quantity) on the same mineral due to different sources the mean value was considered. Exports of gems and diamonds were not taken into consideration in this study.

Gathered data tabulated according to the mineral under the columns of year, quantity and value. Bar charts were developed on the basis of quantity against the time period.

Data on environmental impacts were gathered standard evidence-based protocols that included searching the primary literature, field visits in mining sites, personal communication and personal observations.

RESULTS

Considering the quantity of minerals exported, Ilmanite, Titanium ores, Zirconium ores, Quartz, Granite, Mica, and Graphite are the minerals which are subjected to export in larger quantities. And Ilmanite 319,580 M/T have been exported during the period of 2006-june2013. Titanium ores 285,194 M/T have been exported during the period of 2000-June 2013 (except 2005/2006). Considering the non renewable minerals, Quartz 140,567 M/T; Graphite 66,159 M/T; Granite 42,797 M/T and Mica 26,117 M/T have been exported during the period of 2000 –June 2013. The highest quantity of a single mineral variety exported is a stock of Ilmanite, 75,650 M/T in 2009. The present mineral export trade is about 1% of the Sri Lankan exports.

When considering the foreign revenue earned, mineral exports is 32.9 million US$ in 2011 and 61.3 million US$ in 2012.This is respectively 0.3% and 0.6% of contribution to the national revenue. The foreign revenue earned by 319,580 M/T of Ilmanite is 33,961,683 US$. The biggest non renewable, exported mineral is Quartz, export earnings during the study period is 30,194,097 US$. And Mica 26,117 M/T have been exported and earning is 9014 US$ during the period of 2000 –June 2013.

48 countries have imported minerals from Sri Lanka during the study period. Japan, Malaysia, Netherlands, India, Germany, China, Taiwan, S. Korea, Singapore, Italy, Kenya, Thailand are the main buyers of Sri Lankan Quarts. Main buyers of Natural Graphite are Japan, Pakistan, Germany, Australia, UK, India, Thailand, Singapore and USA. Mineral sands such as Ilmanite, Rutile *etc.* mainly exported to Japan, UK, S. Korea, India, China, Israel and Hong Kong.

There are incidents in attempting to export prohibited or restricted minerals under false declarations. Once eight container loads of Eppawala Rock Phosphate and in another occasion two container loads were attempted to be exported under the guise of "fertilizser" of the same stuff and detected by Customs. There were attempts to export Dolomite, soil, fossils, Rutilated Quartz, under various false declarations.

Table 1A-1L. Quantities/Value of top 12 minerals exported from Sri Lanka during the period of 01 Jan. 2000 – 31 June 2013

HS Code	25.04	
Description	Natural Graphite	
Year	Quantity (Kg)	Value (Rs)
2000	6,938,900	190,933,333
2001	5,982,558	224,789,114
2002	7,134,022	205,245,376
2003	6,430,670	242,934,299
2004	5,023,014	268,749,039
2005	4,597,060	264,354,808
2006	5,276,070	322,840,434
2007	5,515,401	439,942,509
2008	5,184,460	380,120,989
2009	3,067,830	264,066,408
2010	3,210,711	454,521,403
2011	3,342,103	478,836,701
2012	3,081,099	558,418,144
2013 June	1,374,945	264,931,937

Table: 1 A

HS Code	25.05	
Description	Natural Sand	
Year	Quantity (Kg)	Value (Rs)
2000	3,780	15,577
2001	0	0
2002	40,000	949,394
2003	4	116
2004	7,336	113,530
2005	7,632,231	110,365,853
2006	1,960,095	58,968,417
2007	5,468,375	136,672,095
2008	1,811,377	67,688,185
2009	3,458,866	77,399,728
2010	14,340,548	115,745,673
2011	11,232,720	158,542,273
2012	575,529	26,175,662
2013 June	88,165	9,272,543

Table: 1 B

HS Code	25.06	
Description	Quartz	
Year	Quantity (Kg)	Value (Rs)
2000	6,938,900	190,933,333
2001	5,982,558	224,789,114
2002	7,134,022	205,245,376
2003	6,430,670	242,934,299
2004	5,023,014	268,749,039
2005	4,597,060	264,354,808
2006	5,276,070	322,840,434
2007	5,515,401	439,942,509
2008	17,318,283	346,804,686
2009	16,232,963	275,573,216
2010	12,133,696	267,836,570
2011	11,833,926	309,320,186
2012	21,705,155	564,597,367

Table: 1 C

HS Code	25.08	
Description	Other Clay	
Year	Quantity (Kg)	Value (Rs)
2000	21,293	188,734
2001	11,457	808,541
2002	2,466	243,470
2003	11,219	238,202
2004	1,516	97,460
2005	14,371	634,169
2006	0	0
2007	22,227	2,859,477
2008	38,442	1,635,626
2009	13,277	762,873
2010	16,927	685,974
2011	1,431	439,387
2012	11,323	187,906
2013 June	38,432	881,687

Table: 1 D

HS Code	2614.00.10	
Description	Ilmanite	
Year	Quantity (Kg)	Value (Rs)
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	30,709,581	31,025,221
2007	75,002,818	555,007,250
2008	8,729,289	118,790,222
2009	75,649,651	431,814,331
2010	27,224,648	379,393,345
2011	43,877,242	912,216,543
2012	49,575,845	1,945,889,106
2013 June	8,210,680	250,096,667

Table: 1 E

HS Code	25.25	
Description	Mica	
Year	Quantity (Kg)	Value (Rs)
2000	1,286,900	33,470,483
2001	1,078,200	35,406,499
2002	1,202,500	44,285,761
2003	1,632,875	57,705,504
2004	1,324,100	49,068,994
2005	1,586,493	61,949,071
2006	2,279,628	97,081,914
2007	3,048,608	133,903,555
2008	2,172,713	104,141,613
2009	2,250,824	109,024,234
2010	1,971,065	119,305,508
2011	2,939,500	139,188,094
2012	2,449,710	166,468,134
2013 June	893,100	52,277,732

Table: 1 F

HS Code	26.14	
Description	Titanium ores and concentrates	
Year	Quantity (Kg)	Value (Rs)
2000	720,000	28,781,242
2001	3,373,440	109,104,455
2002	703,200	30,908,158
2003	236,000	9,433,434
2004	3,543,000	41,783,095
2005	9,479,999	285,659,610
2006	0	0
2007	0	0
2008	21,947,242	438,962,621
2009	79,421,658	564,979,215
2010	49,421,658	672,406,223
2011	48,540,480	1,255,058,374
2012	59,678,494	2,860,532,099
2013 June	8,128,180	250,778,541

Table: 1 G

HS Code	26.15	
Description	Zirconium, Vanadium...etc	
Year	Quantity (Kg)	Value (Rs)
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	13,199,000	607,749,928
2005	0	0
2006	0	0
2007	0	0
2008	21,246,746	211,879,648
2009	7,929,210	149,533,125
2010	12,140,671	216,409,369
2011	19,696,645	205,617,924
2012	3,635,000	307,924,655
2013 June	714,000	143,574,419

Table: 1 H

HS Code	2614.00.20	
Description	Rutile	
Year	Quantity (Kg)	Value (Rs)
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	23,221,619	298,446,084
2007	46,604,961	573,642,785
2008	3,305,841	130,816,858
2009	6,029,182	152,770,351
2010	1,914,254	180,579,004
2011	2,265,543	293,405,721
2012	1,385,506	461,199,411
2013 June	15,000	1,363,747

Table: 1 I

HS Code	68.15	
Description	Articles of stone	
Year	Quantity (Kg)	Value (Rs)
2000	36,597	1,494,186
2001	42,300	3,511,421
2002	69,572	10,829,491
2003	106,404	7,850,567
2004	96,591	5,552,799
2005	0	0
2006	0	0
2007	0	0
2008	200,072	50,168,832
2009	176,957	129,181,009
2010	251,181	54,539,353
2011	211,970	214,374,139
2012	232,292	512,076,394
2013 June	105,772	408,864,697

Table: 1 J

HS Code	2615.10	
Description	Zirconium ores & concentrates	
Year	Quantity (Kg)	Value (Rs)
2000	0	0
2001	2,500	32,354
2002	19,108,002	154,502,508
2003	5,708,200	63,150,571
2004	0	0
2005	0	0
2006	0	0
2007	0	0
2008	21,246,746	211,879,648
2009	7,679,210	133,166,700
2010	12,069,278	211,678,158
2011	19,426,645	154,870,196
2012	3,635,000	307,924,655

Table: 1 K

Plate. 1A-1L. Quantities of top 12 minerals exported from Sri Lanka during the period of 01 Jan. 2000 – 31 June 2013

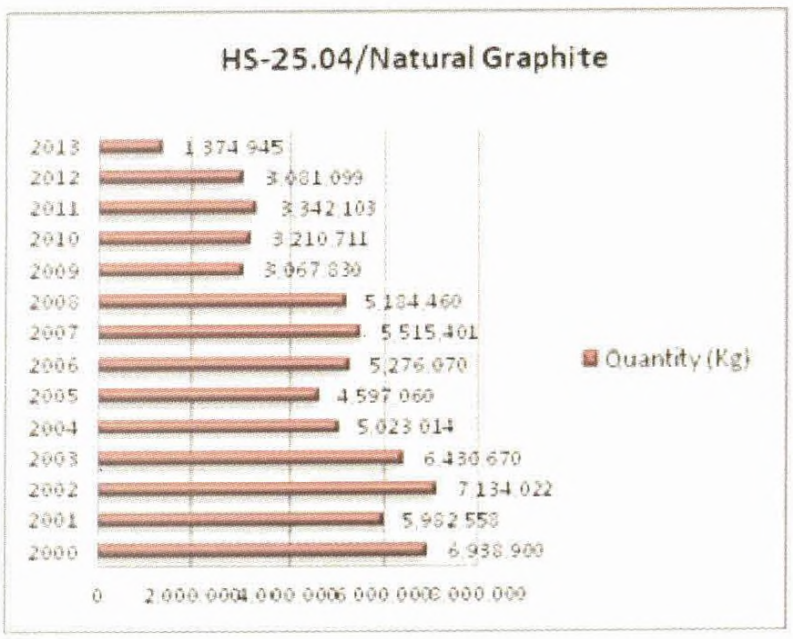


Figure: 1A

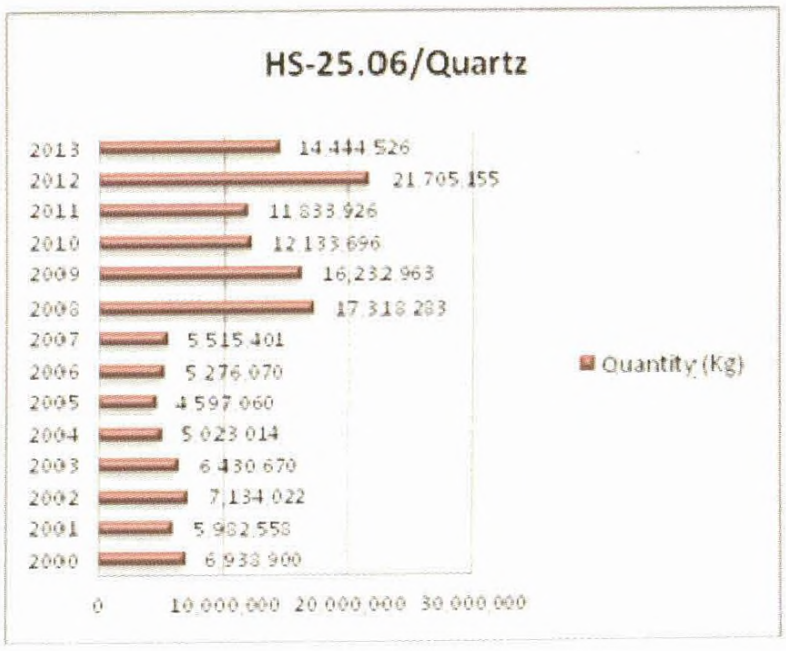


Figure: 1C

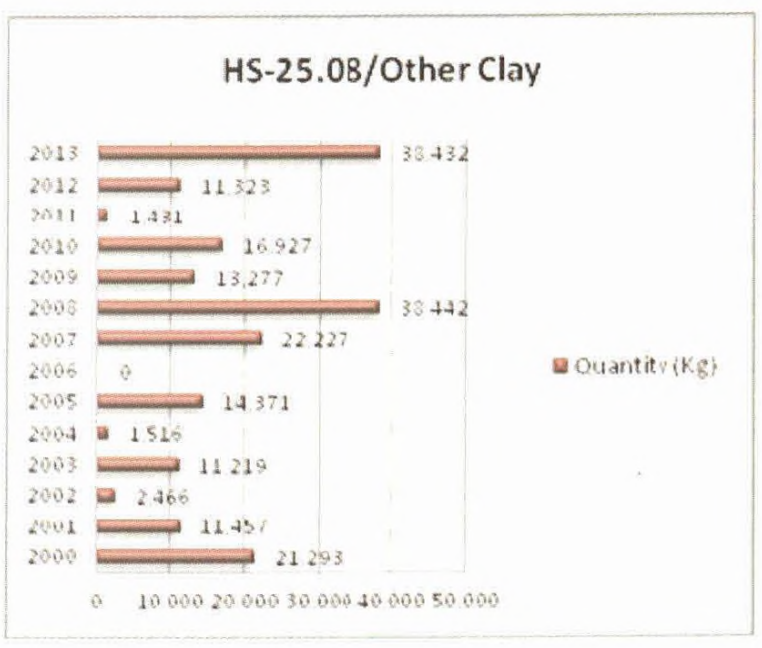


Figure: 1D

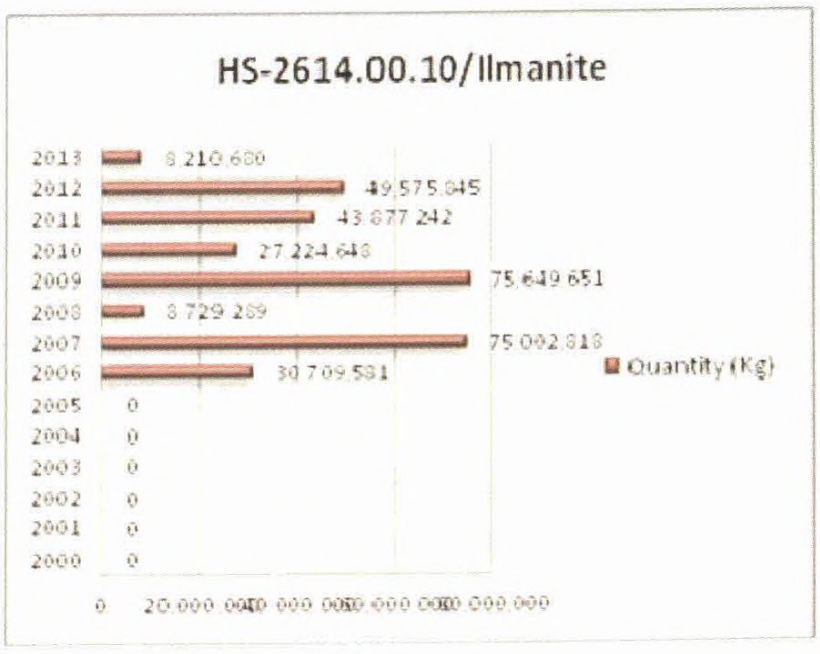


Figure: 1E

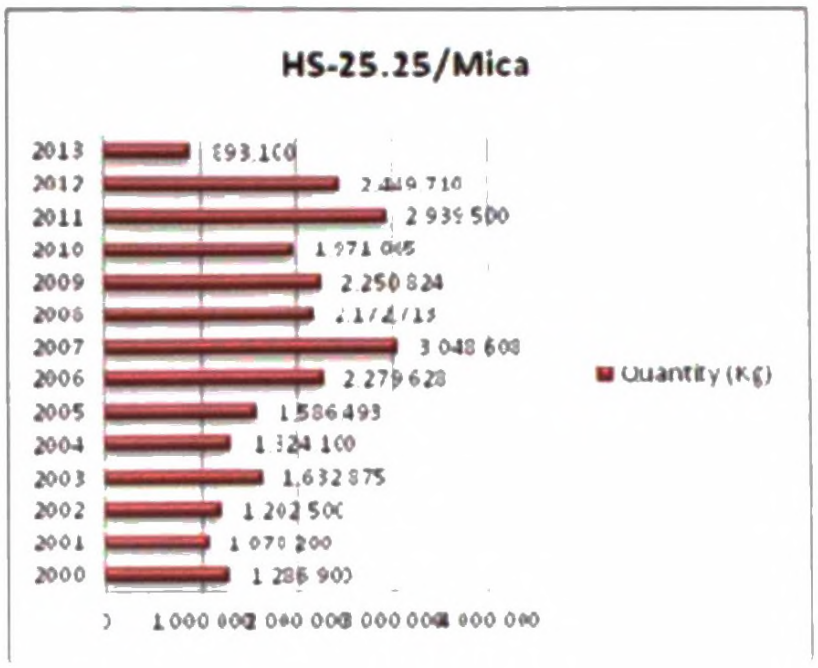


Figure: 1F

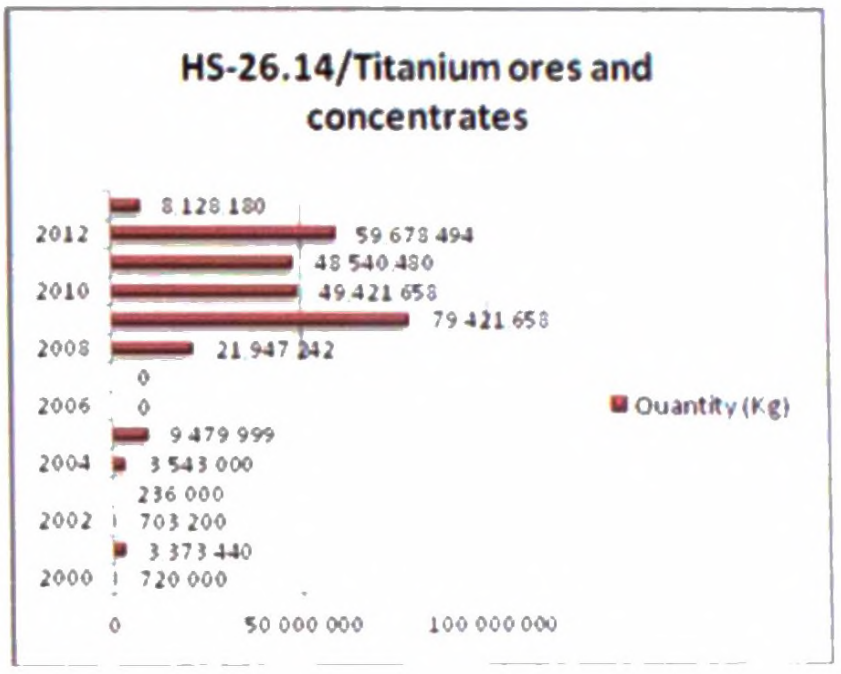


Figure: 1G

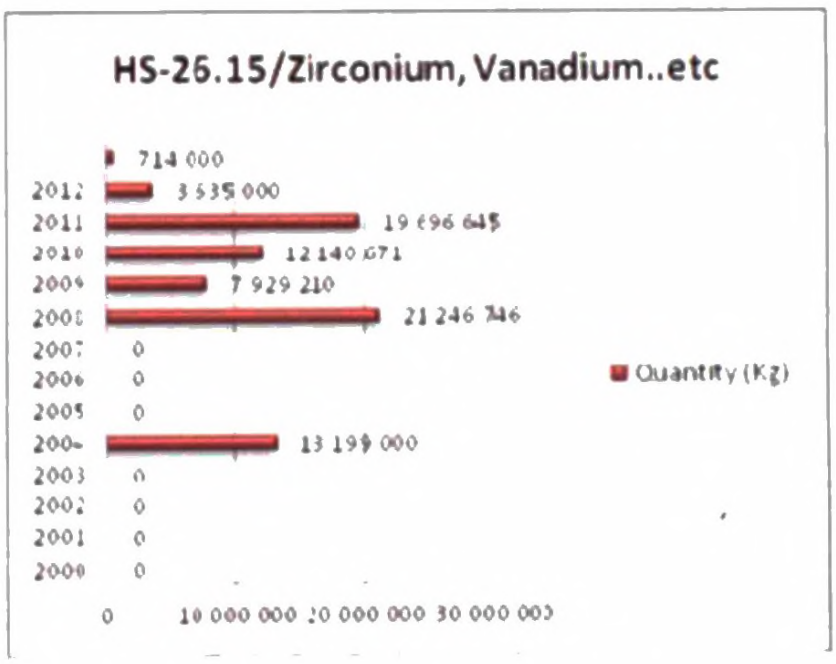


Figure: 1H

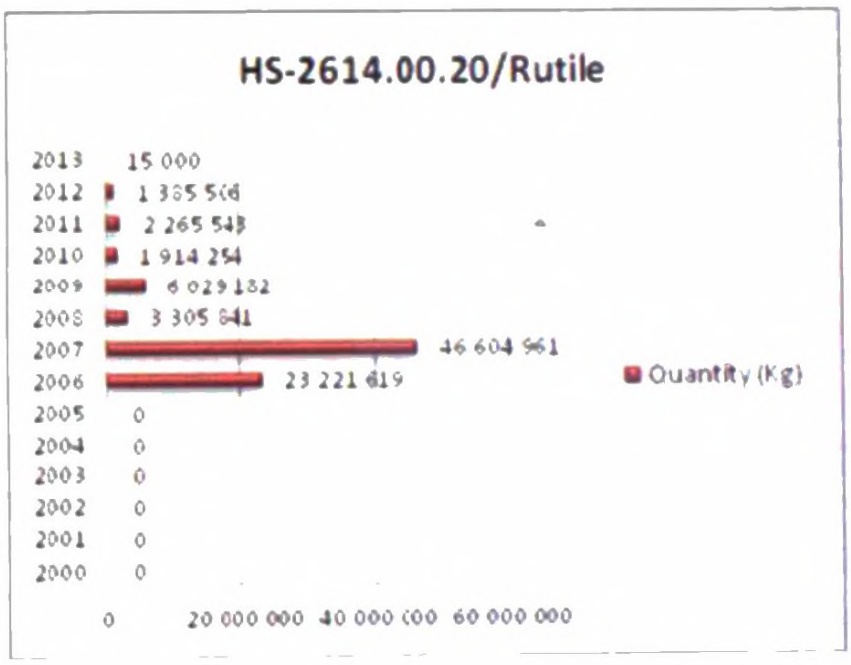
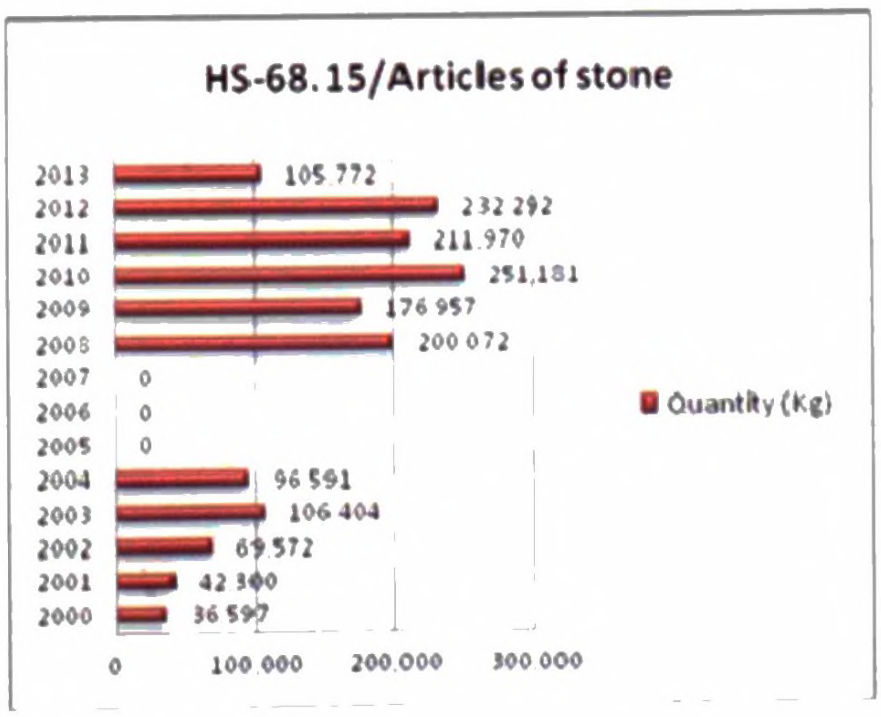


Figure: 1I



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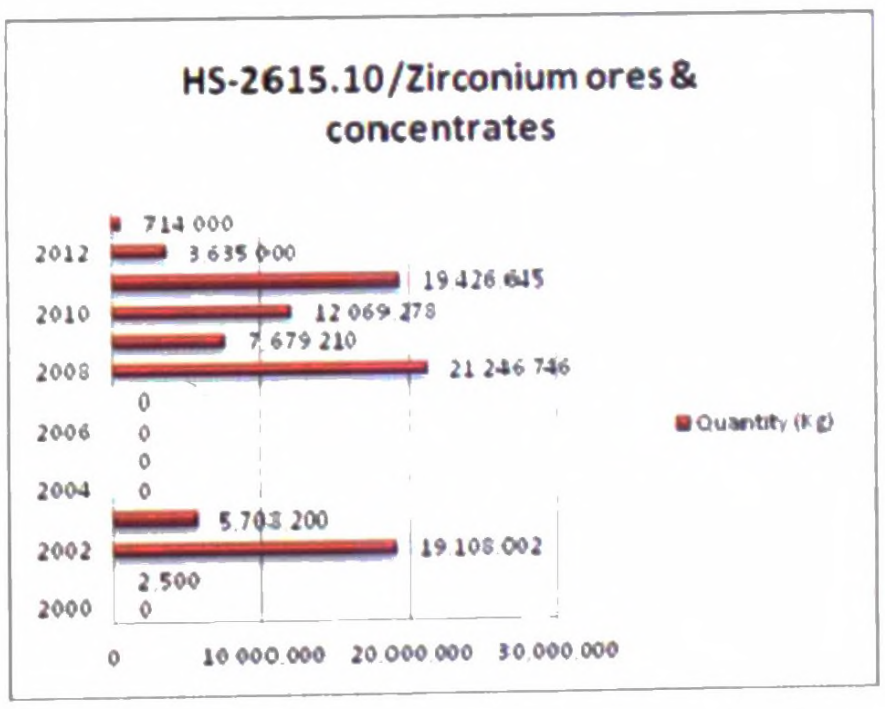

Figure: 1K

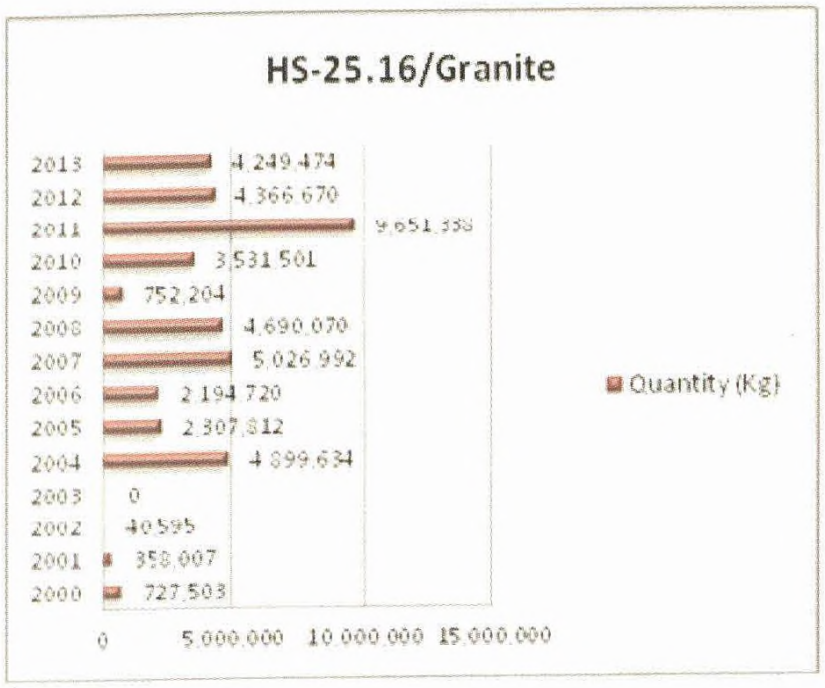

Figure: 1 L

DISCUSSION

The monthly/annually export quantities of minerals clearly indicate that natural Graphite, Quartz, Granite, Mica, Ilmanite have a stable demand in the export trade. The drastic decline of exports of the Ilmanie in the year 2013 and Rutile from 2008 can be observed. There is a large increment in the export volume of Zirconium, Zirconium ores & concentrates, Titanium ores & concentrates since 2008. Export of natural sand in huge volumes was started in 2005 and seems to be halted in 2011.

As the demand for quartz the world over has increased because the deposits in Brazil are nearing exhaustion and the Quartz found in India and China is not as pure as in Sri Lanka. The world market value for Quarts is US$ 400- 4500 M/T depending on the quality and variety. Generally, pure Silica Quartz fetches US$ 2500-3000M/T but the export price in Sri Lanka is US$ 100- US$ 175 for rough Quartz and semi processed as Quartz grits US$ 190- US$ 300 M/T, which is a matter should to be considered seriously. Also this is the only exported item an export duty is applicable at Customs.

The natural Graphite in Sri Lanka, which is supposed to be the finest quality in the world market, was exported for US$ 700-800M/T. The export price is 139 US$ M/T.

Mica PGP is exported for 410-570 M/T. Granite blocks (w/l) are exported for 500-800 M/T.

According to the provisions of Mines and Minerals Act, no mineral can be exported without a valid permit. The detection of illegal export of "Eppawala Rock Phosphate" revealed that the price obtained for 10 container loads of the material is 90 US$ per M/T.

International market for Rutile is 2000 US$ for low and 2445 US$ for high quality variety.

Value addition on these raw materials may direct towards earning more foreign exchange. It may be multi-folded, if the high-tech local industries such as fused Quartz, chips, nanotechnology based enhancements *etc.* are established.

Minerals washed and gathered at eastern and South –eastern shores such as Rutile, Ilmanite, Zirconium ores, Titanium ores *etc.* are regenerated and renewable.

Other minerals are non-renewable. Extraction of those non-renewable minerals in Sri Lanka should be done in a sustainable manner by taken suitable mitigation measures on the massive environmental destructions. It should mitigate the impacts on soil-biodiversity when extracting and processing of the mineral resources.

(Siltation and sedimentation were observed in processing mica, gem mining *etc.* Contamination of rivers, groundwater, alteration of surface and groundwater flow , erosion and instability, loss of soil were observed in gem mining. Destruction of Miocene fossils and safety hazard pits during and after mining were observed in extracting the limestone in Puttlam Habitat destruction and alteration was observed in many mining sites including Quartz, Mica, Dolomite, Limestone, Clay *etc.* Noise pollution was observed when blasting the rocks of Quartz, Granite and Dolomite.

It has estimated the radiological impacts due to mining, processing in phosphate industrial activities; Khater *et al* (2001).This is a matter for consideration in extraction of Phosphate deposits of Sri Lanka.

Many developing countries are losing out both economically and ecologically by specialization on the export of natural resources. In addition the authors state the costs and benefits of the export of natural resources are distributed highly unequally within developing countries Muradian *et al* ,(2001) and Behrens *et al* (2005). World-economic integration allow for developed countries to treat less developed countries as supply depots to satisfy their unsustainable resource consumption levels, which often leads to deforestation and increased environmental degradation in many less developed countries, Jorgenson (2010). This is a factor to be considered seriously in Sri Lanka.

There is an existence of a monopoly among a few exporters, and as much as these minerals are collected from natural habitats the overheads are low. Many of the exporters have not touched the correct world market and, perhaps, they are not concerned with it. Hence, the country does not receive the actual foreign exchange that can be obtained.

CONCLUSIONS AND RECOMMENDATIONS

Sri Lanka is rich with both renewable and non renewable mineral resources. However, the country does not receive proper revenue out of those resources. Following recommendations are made for sustainable utilization and earn better foreign exchange earnings;

1. Establish and Promote mineral based local industries, especially on Quartz based manufacturing.
2. Export of raw materials should be in value added forms. .
3. Separation of mineral sands such as Ilmanite, Rutile, Monozite, Titanium ores, Zirconium ores etc. of Pulmoddai should be done with modern technology for better value addition process.
4. Use more advance technology in extracting, separating and manufacturing of products.
5. Explore the possibilities for use of nanotechnology in mineral industry.
6. Capture the correct international market.
7. Establish and enforce minimum exportable prices.
8. Address the gaps in legislation.
9. Address sufficient mitigation practices on environmental destructions.
10. Take necessary action to minimize the destruction and to conserve the Miocene Fossils.
11. Promote research on minerals, especially fossils.
12. Stern action against the violators, environmental destructors and culprits on mineral issue.

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