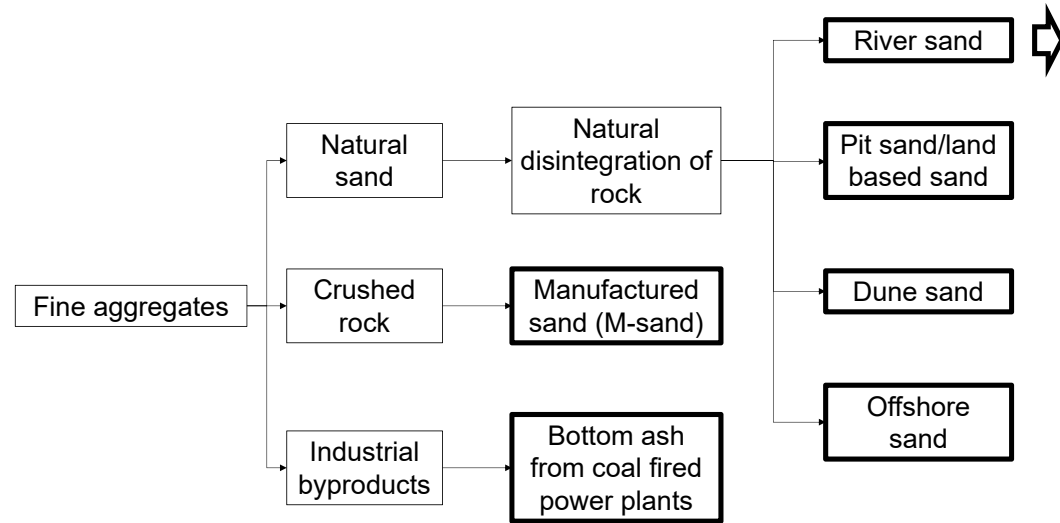


# Fine aggregates for construction works

Prof. SMA Nanayakkara  
University of Moratuwa

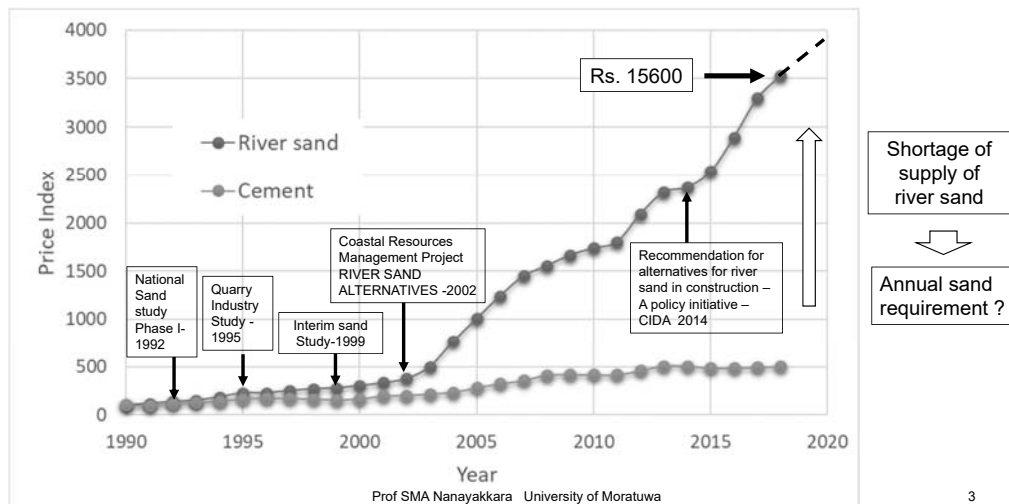
1



Prof SMA Nanayakkara University of Moratuwa

2

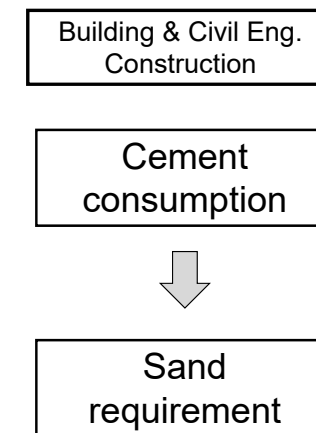
## Price Indices - CIDA



Prof SMA Nanayakkara University of Moratuwa

3

## Estimation of annual sand requirement



Prof SMA Nanayakkara University of Moratuwa

4

Application	Mix proportion (by bulk volume) Cement:Sand	Volume of sand needed for 1 tonne of cement (m <sup>3</sup> )
Concrete	1:2	1.4
Mortar for brick work, blockwork and rubble work	1:8	5.6
Plastering	1:5	3.5

### Cement and Sand Requirement for House Construction

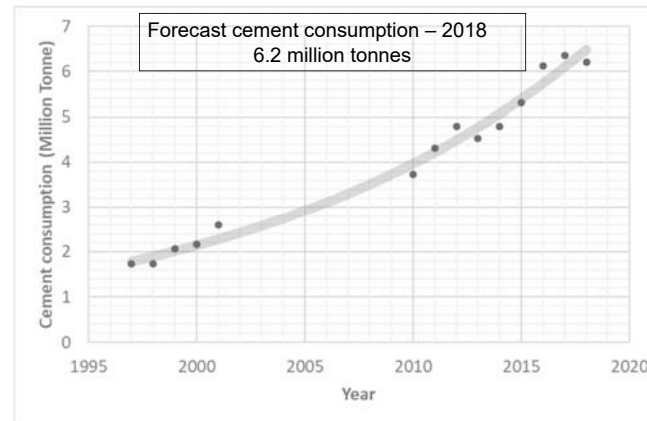
House Type	Floor Area (m <sup>2</sup> )	Cement (kg)	Sand (m <sup>3</sup> )	Sand requirement per tonne of cement (m <sup>3</sup> )
1B1	82.1	6565	24.7	3.76
1B2	74.8	7845	28.8	3.67
1B3	74	6590	24.3	3.69
1B4	75.6	8090	29.5	3.65
1B5	114.2	9935	36.1	3.63

**Sand requirement = 3.6 m<sup>3</sup> per tonne of cement**

**Demand for sand**

## SAND DEMAND

### Cement Consumption in Sri Lanka



**Main consumers of cement**

**House Builders ( 70 %)**

**Estimated Sand Demand in 2018**

**22 Million m<sup>3</sup>**

**Western Province (40%) – 9 Million m<sup>3</sup> (3.2 Million cubes)**

**Sand Supply ?**

**Sand Mining in all Major Rivers**

Deduru Oya, Maha Oya, Kelani Ganga, Kalu Ganga, Mahaweli, Yan oya, Gin Ganga and Nilwala Ganga

**Heavily mined to meet the increasing demand**



Ratnayake, R.(2008) River Sand Mining – Boon or Bane? A synopsis of a series of national, provincial and local level dialogues on unregulated/illegal river sand mining, Sri Lanka Water Partnership

**Impacts of uncontrolled river sand mining**

Coastal erosion  
Lowering of riverbed levels  
Salt water intrusion  
River bank collapses

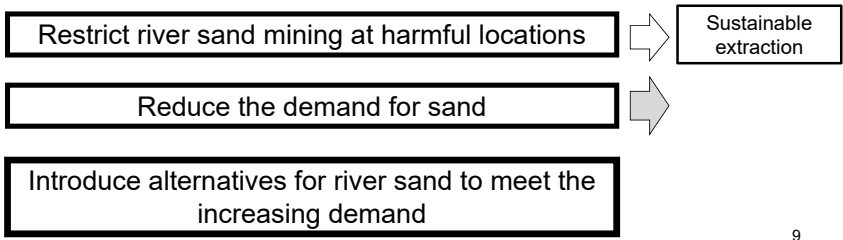
Agriculture  
Water supply  
Fisheries  
Tourism

**Solutions ?**

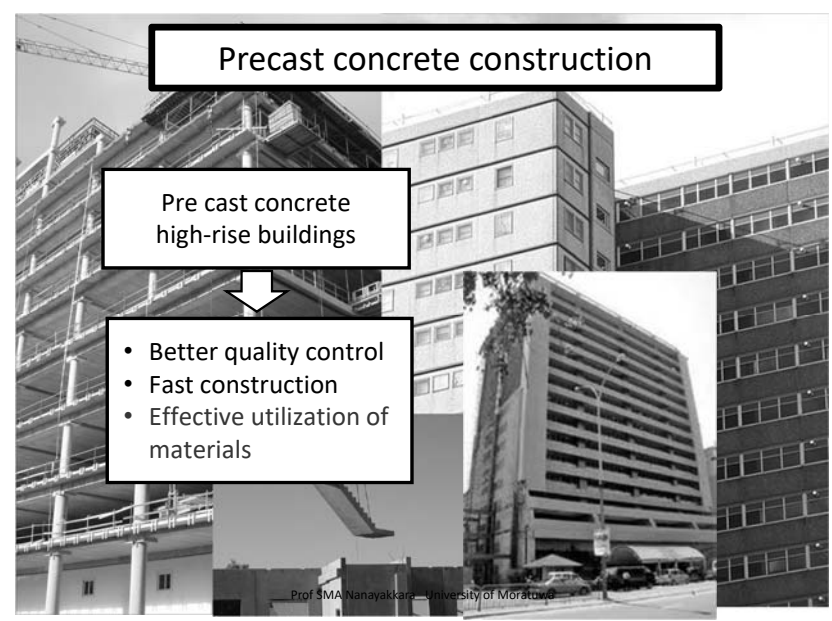
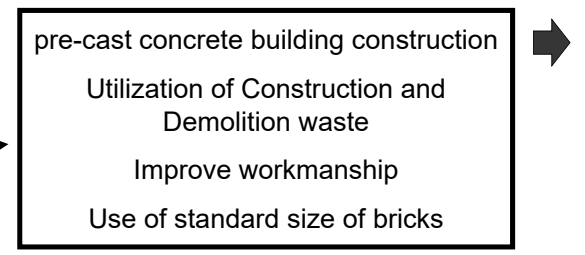
### Impacts of large scale and uncontrolled river sand mining

- Coastal erosion
- Lowering of riverbed levels
- Salt water intrusion
- River bank collapses

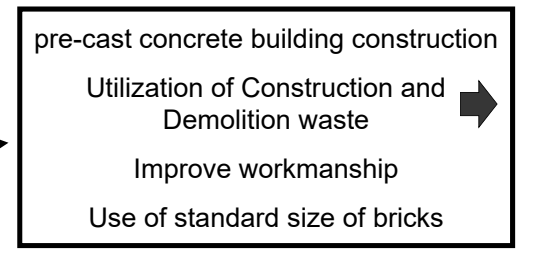
### Solutions



### Reduce the demand for sand in building construction

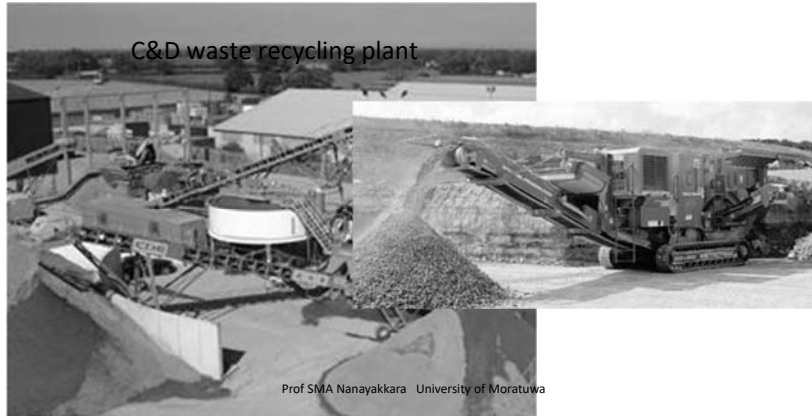


### Reduce the demand for sand in building construction



Utilization of Construction and Demolition waste

Concrete and masonry → recycled aggregate



Reduce the demand for sand in building construction

pre-cast concrete building construction  
Utilization of Construction and Demolition waste  
Improve workmanship →  
Use of standard size of bricks



Poor workmanship →  
• Waste of materials  
• Time delay

quality conscious → Commitment

Reduce the demand for sand in building construction

pre-cast concrete building construction  
Utilization of Construction and Demolition waste  
Improve workmanship  
Use of standard size of bricks →

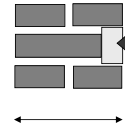
### Variations in brick size

Length(mm)	Width(mm)	Height(mm)
185.7	88.3	43.6
183.5	90	43
187	88	44
185.23	89.6	44.2
186.36	89.2	45.48
189.52	89	44.08
185.57	89.8	47.83
191.1	92.1	44.6
188.4	90.4	47.4
185.7	93.93	48.47
190.79	91.96	48.32
199.87	101.68	37.77
202.17	101.03	41.5
218	92.5	68.5
206	98.8	67.2
<b>215</b>	<b>102.5</b>	<b>65</b>

Standard size



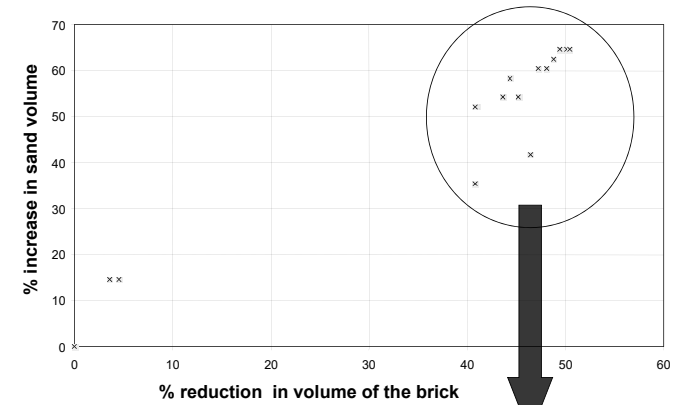
Standard size



Extra mortar

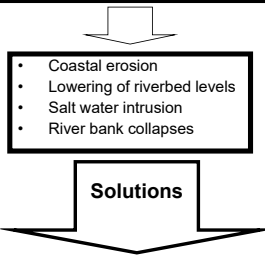
Non standard size

### Increase in sand requirement for 225mm (9 ") wall



For 8" wall, the increase in sand requirement is 20%

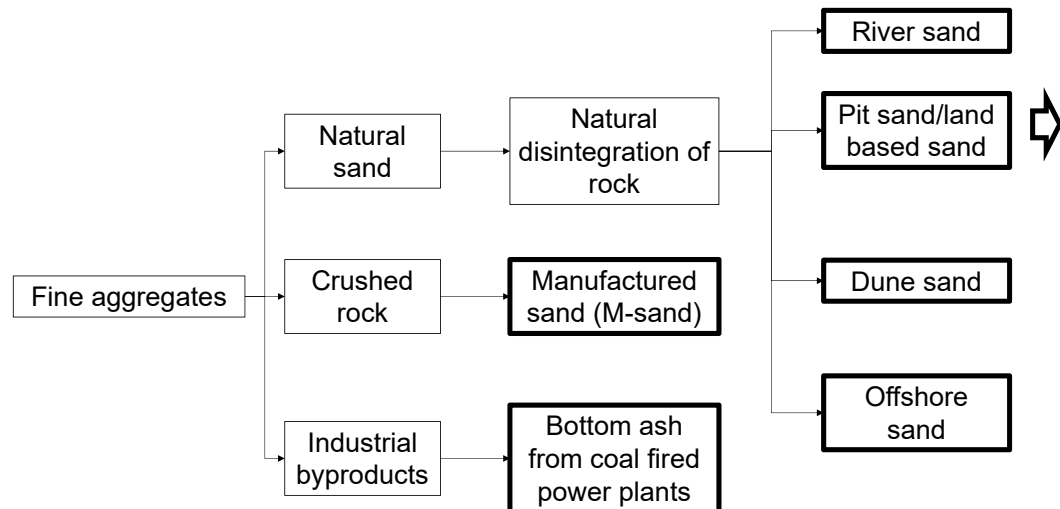
### Impacts of large scale and uncontrolled river sand mining



Restrict river sand mining at harmful locations

Reduce the demand for sand

Introduce alternative fine aggregates for river sand to meet the increasing demand

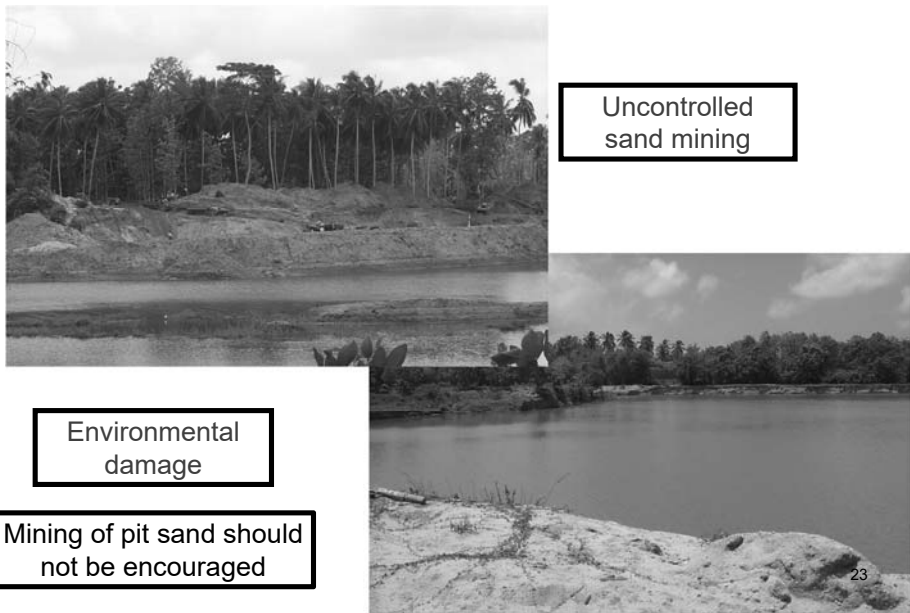




Pit sand



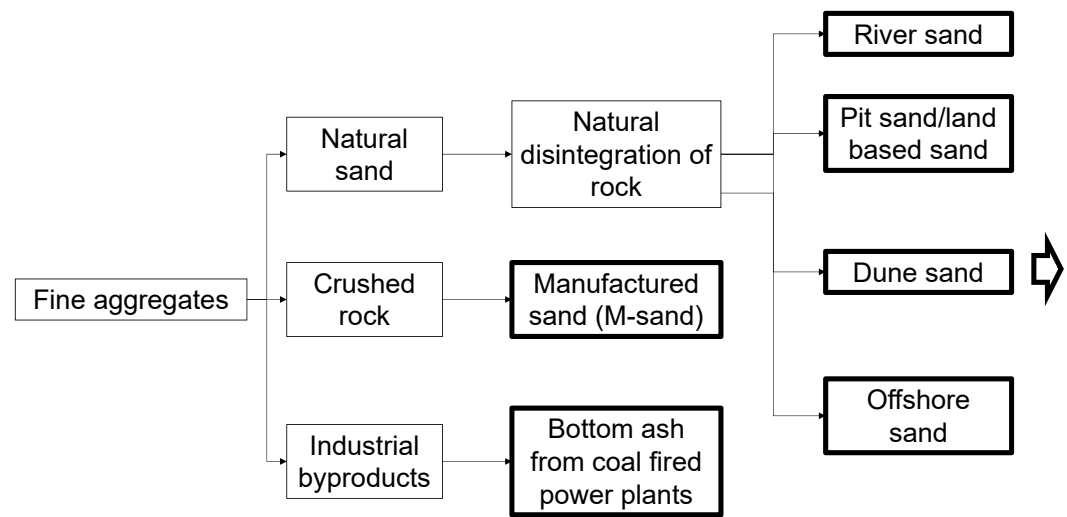
Pit sand



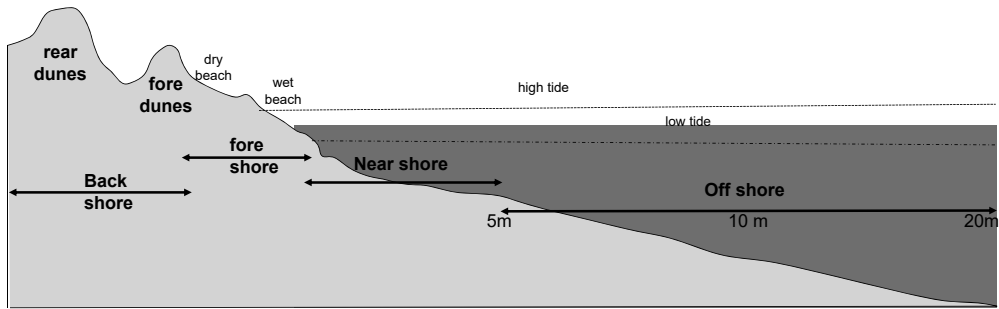
Uncontrolled sand mining

Environmental damage

Mining of pit sand should not be encouraged



### Profile a healthy beach



[J Floor Anthoni (2000) www.seafriends.org.nz/oceano/beach.htm]

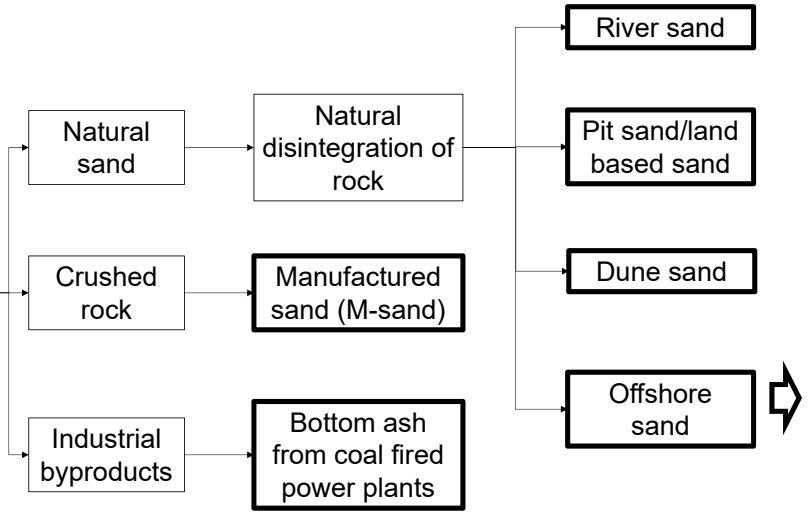
Dunes are part of the active coastal system

Dunes provide habitat for highly specialized plants and animals, including rare and endangered species. They can protect beaches from erosion and recruit sand to eroded beaches.

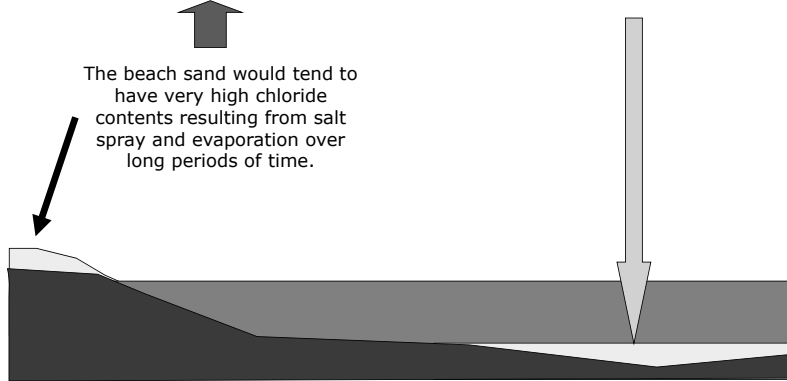


No sand extraction from dunes or beach should be allowed

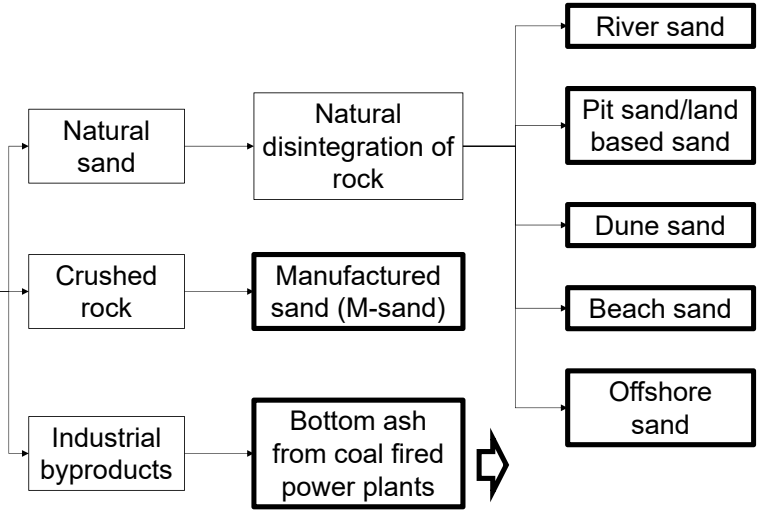
Fine aggregates



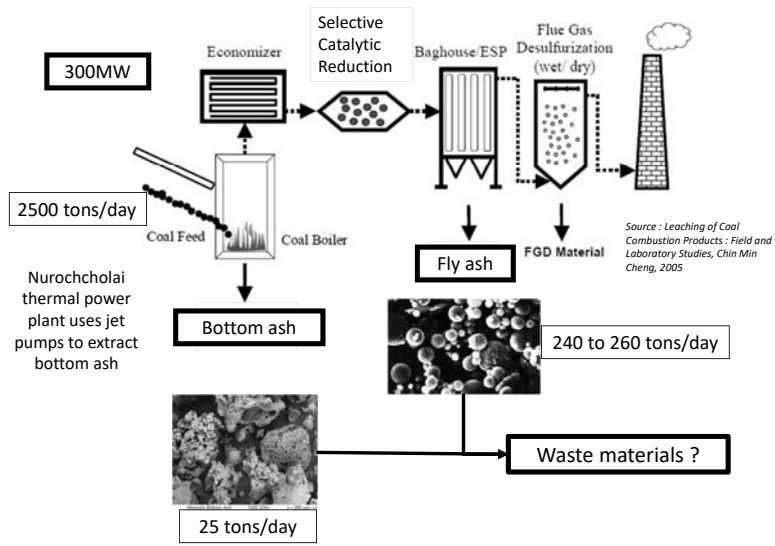
### Beach Sand ≠ Offshore sand



Fine aggregates



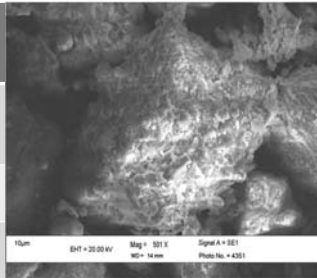
**Coal combustion process and generation of coal combustion waste**





## Physical Properties of bottom ash

Property	Bottom Ash	River sand	BS EN 13055 requirement for lightweight aggregate
Loose bulk density	600kg/m <sup>3</sup>	1450kg/m <sup>3</sup>	< 1200 kg/m <sup>3</sup>
Particle density	1500-1750 kg/m <sup>3</sup>	2600-2750 kg/m <sup>3</sup>	< 2000 kg/m <sup>3</sup>
Water absorption	17-30%	0.4-1.0%	-



Bottom Ash



Lightweight aggregate

Prof SMA Nanayakkara University of Moratuwa

33



Prof SMA Nanayakkara University of Moratuwa

34

## Concluding remarks

- Offshore sand and Manufactured sand can be considered as two viable alternatives meet the increasing demand for river sand.
- Production of manufactured sand as the main product should be encouraged
- Appropriate construction practices should be adopted to minimize use of sand.
- Utilization of Construction and Demolition waste to produce recycled aggregate should be facilitated by relevant authorities.
- Bottom ash can be utilized as a light weight fine aggregate to masonry units and other products.
- Extraction of dune and pit sand can cause unrecoverable environmental damage. Necessary actions should be taken to avoid further destruction

Prof SMA Nanayakkara University of Moratuwa

35

## River sand is a precious natural resource

We must not waste it

Use it only where it is essential



Use Alternative materials to protect the environment

Prof SMA Nanayakkara University of Moratuwa

36

# ACTION PLAN TO PROMOTE ALTERNATIVES FOR RIVER SAND



Action	Responsible Institutions	Co-coordinating Agency
Revising specifications on the use of fine aggregate for construction and structural applications	CIDA and other agencies	CIDA
Improve the quality of off-shore sand supply by providing washing and grading equipment	SLLRDC and potential investors	SLLRDC
Reviewing and revising CEA licensing period of EPL for operating quarry operation/rock crusher	CEA	CEA
Revising of GSMB regulations and licensing processes such as on explosives permits.	GSMB, MOD	GSMB
Revise the number of permits/clearances required to start a new quarry to be streamlined wherever possible	GSMB, CEA, MOD, Department of Archeology, Local Authority, Divisional Secretariat, Explosive controller, Police.	GSMB
Amendment of the Mines and Minerals Act and regulations	GSMB, Line ministry	GSMB
Revision of National Sand Policy	GSMB	GSMB
Minimize the political interference in the implementation of regulations on river sand	Presidential Secretariat	
Tax concession and special bank loan facilities for investors	Ministry of Finance & BOI	CIDA
Introduction of quality assurance system & product certification for sand.	SLSI	SLSI
Awareness programmes on the use of alternative sands to the end users.	CIDA	CIDA