Country Report Presentation-Sri Lanka

Seminar on Water Resources Management & Small Hydropower Development for the Countries Under Belt and Road Initiative

15th May - 04th June 2018

Conducted by

HRC- China

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OUTLINE

- Overview
- Water Resources Development and Management
- General condition of energy and power of the country
- Condition of hydropower development
- Some of the multipurpose development projects
- Hydropower Projects to be constructed with installed capacity under 50 MW
- Difficulties and barriers in water resources management and small hydropower development.

Overview

Geography

Sri Lanka is a small Island located in the Indian Ocean. It is a Tropical Country.

Located at Latitude :
Between 5^0 55' and 9^0 50' North
Between 79^0 42' and 81^0 53' East

- Land area - 65,610 km^2
- Maximum length 435 km and width 240 km, coastline 1340 km.
- Central hills surrounded by plain rise from sea level to 300 m (2/3 of land area).
- Highest Peak level 2,524 m high above MSL.
- Major rivers are originating from central hills with average annual rainfall of 2900 mm.

Overview

Contd…

Geography

- Land use

  Water - 870 km^2

  Land Area - 64,740 km^2

- Arable land - 44.92 %

  Cultivated - 56.00 %

  Sparsely used - 44.00 %

- Forest lands - 30%
- Natural resources -

  Limestone, Graphite, Mineral sands, Gems, Phosphates and Clay

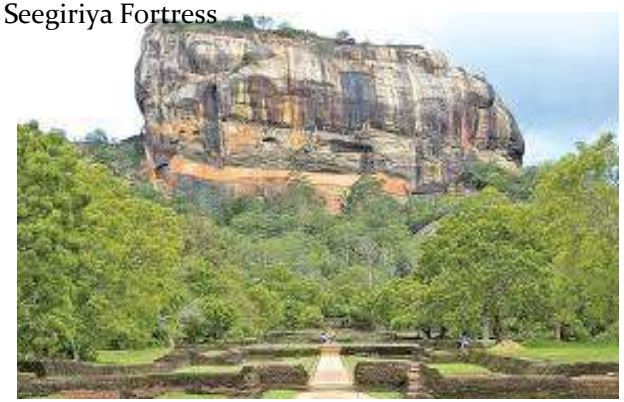
Overview

Culture and Heritage


Dalada Maligaya - Kandy


Kandy Procession


Kandy Procession


Seegiriya Fortress


Seegiriya Fresco


Polonnaruwa Kingdom – Madirigiriya Watadagaya


Polonnaruwa Kingdom – King's Palace

Overview

Contd…

Culture and Heritage

Medirigiriya Watadayaga


Ruwanweliseya


Sadakada Pahana

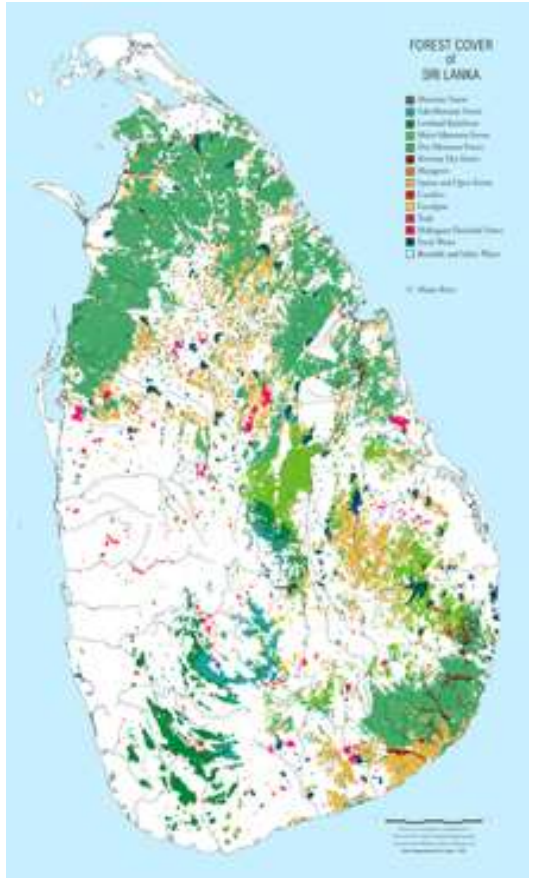

Avukana Buddha Statue


Dambulla Temple

Overview

Contd…

Sceneries

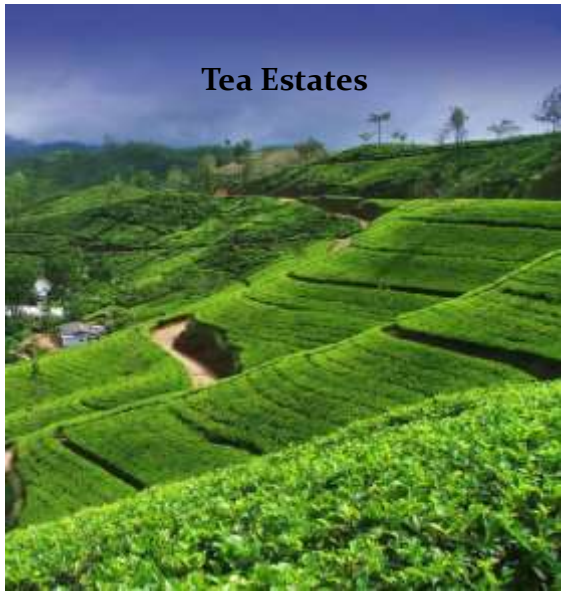



Sinharaja Forest Reserve

Overview

Contd…

Sceneries



Udawalawa Sanctuary

Overview

Contd…

Sceneries

Yala Sanctuary

Gem mining

Hikkaduwa Beach

Negambo Beach

Nilaveli Beach

Overview

Contd…

Climate

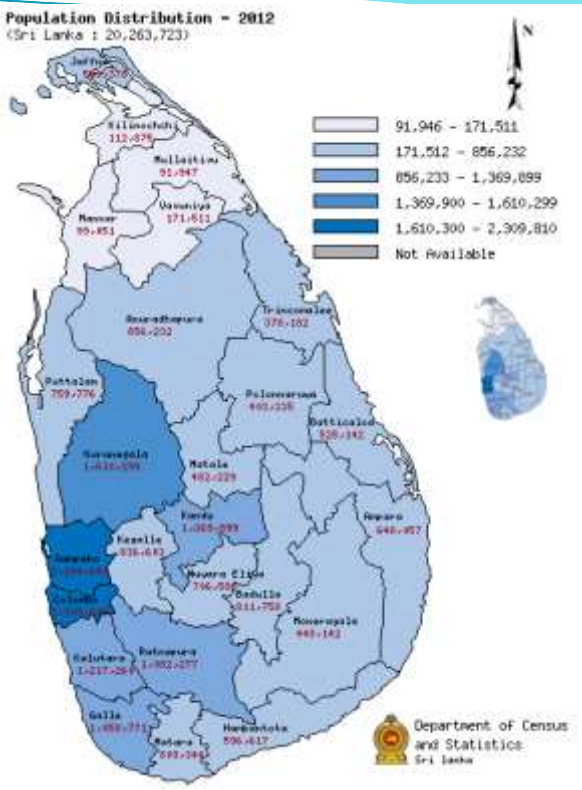
- Tropical & with two distinct monsoonal rainy periods

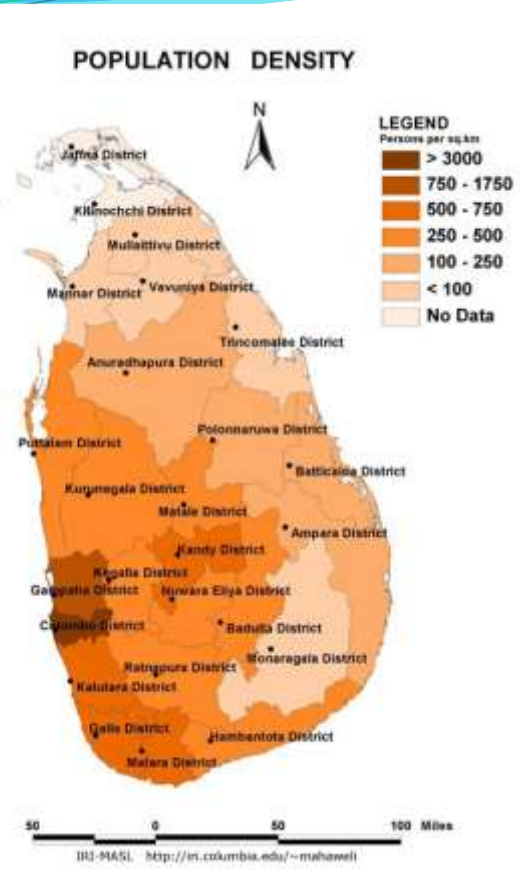
Day time average temperature	Lowlands – 27.5 ^{o} C & Upland 17.5 ^{o} C
Minimum Temperature	21^{o} C in Lowlands & 9.5 ^{o} C in Uplands
Coldest months	December & January
Warmest months	April, May, June, July
Humidity	through out the year between 70 to 80%.
Average annual precipitation	1860 mm.
Evaporation	1450 mm in Dry Zone 1000 mm in Wet Zone.
Normal highest wind speed	23 – 27 km / hr
Average wind speed	10 – 15 km / hr.

Overview

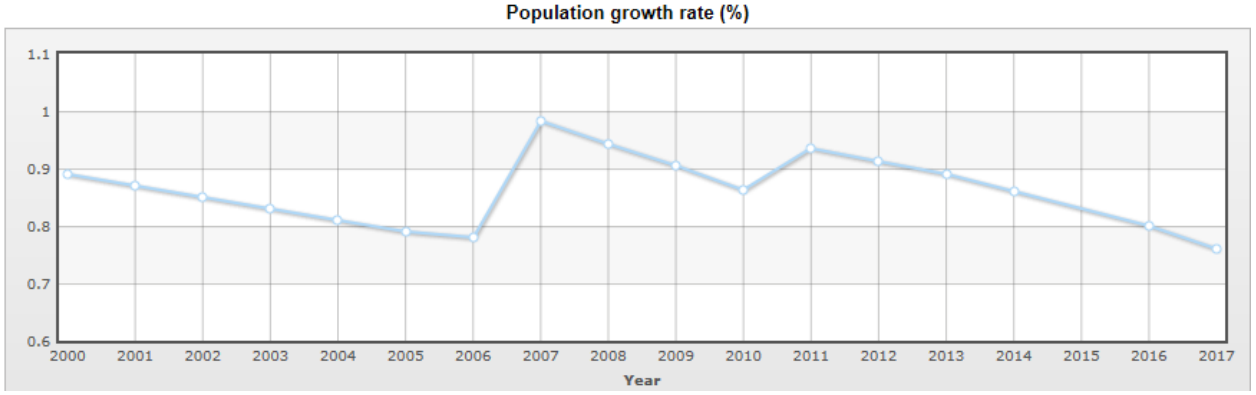
Population

Population	20.9 million, 2018. (0.27% of the total world)
Ranks	58 in the list of countries
Population density	334 per Km² (865 people per mi²).
Land area	65,610 Km² (24,212 sq. miles)
Urban Population	19.6 % of the (4,095,751 people in 2018)
Median age	32.7 years.





Source: Department of Census and statistics in Sri Lanka



Overview

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Economic structure

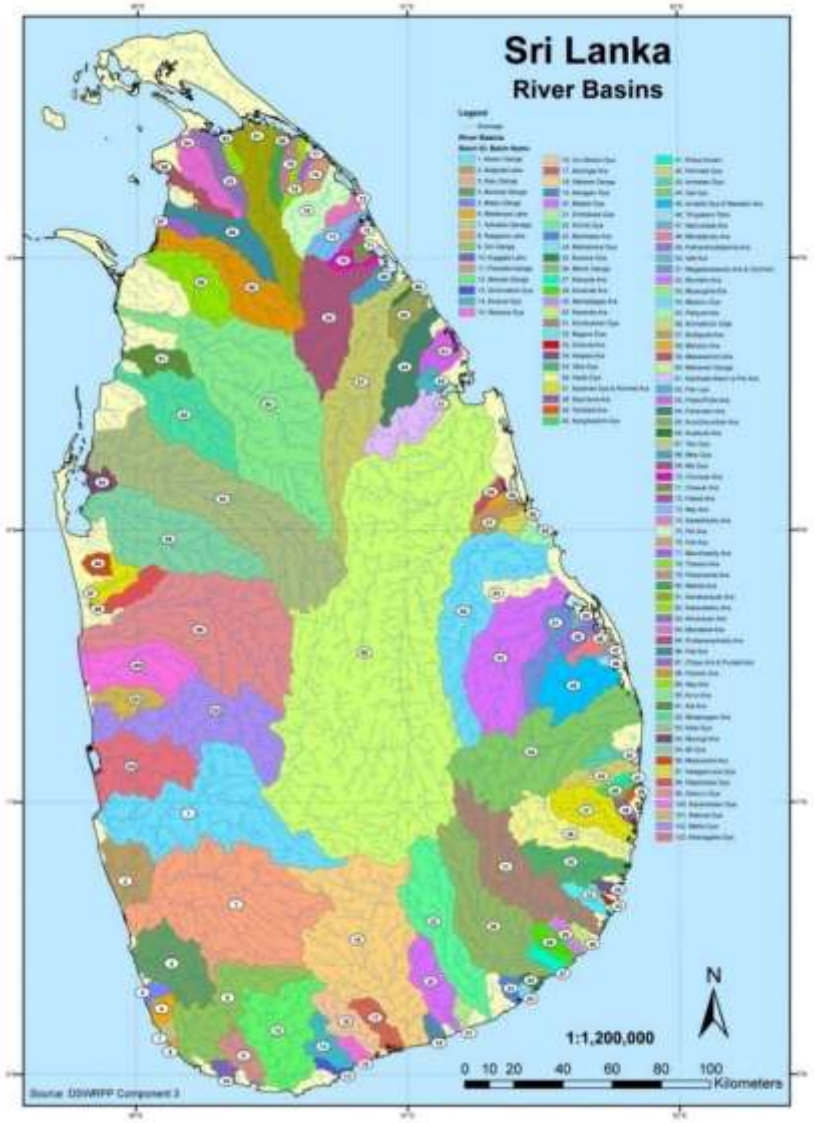
	GDP Contribution	Sector
Primary sector	11 %	farming, fishing, aquaculture
Secondary sector	31%	Industrial, manufacturing
Tertiary sector	58%	trading, transport, tourism

- Economic growth rate – 4.0 % in 2017.
- Significant improvements in the areas such as the growth rate, increased level of investment, low inflation, very low unemployment, buoyant external trade and booming tourism.
- Overall GDP stood at US $ 88 Billion with the per capita income was US $ 4,065 in 2017.

Water Resources Development Management

Contd…

River Network in Sri Lanka



General facts

- 103 distinct river basins covering 90 percent of the island.
- Only 17 of the 103 basins exceed 1,000 km^2
- Only 5 basins over 2,500 km^2

  (Mahaweli River, Kalu River, Deduru Oya, Malwathu Oya & Kala Oya)
- Total internal renewable surface water resource estimated at 50 km^3/year.
- Internal renewable groundwater resources estimated at 7 km^3/year.

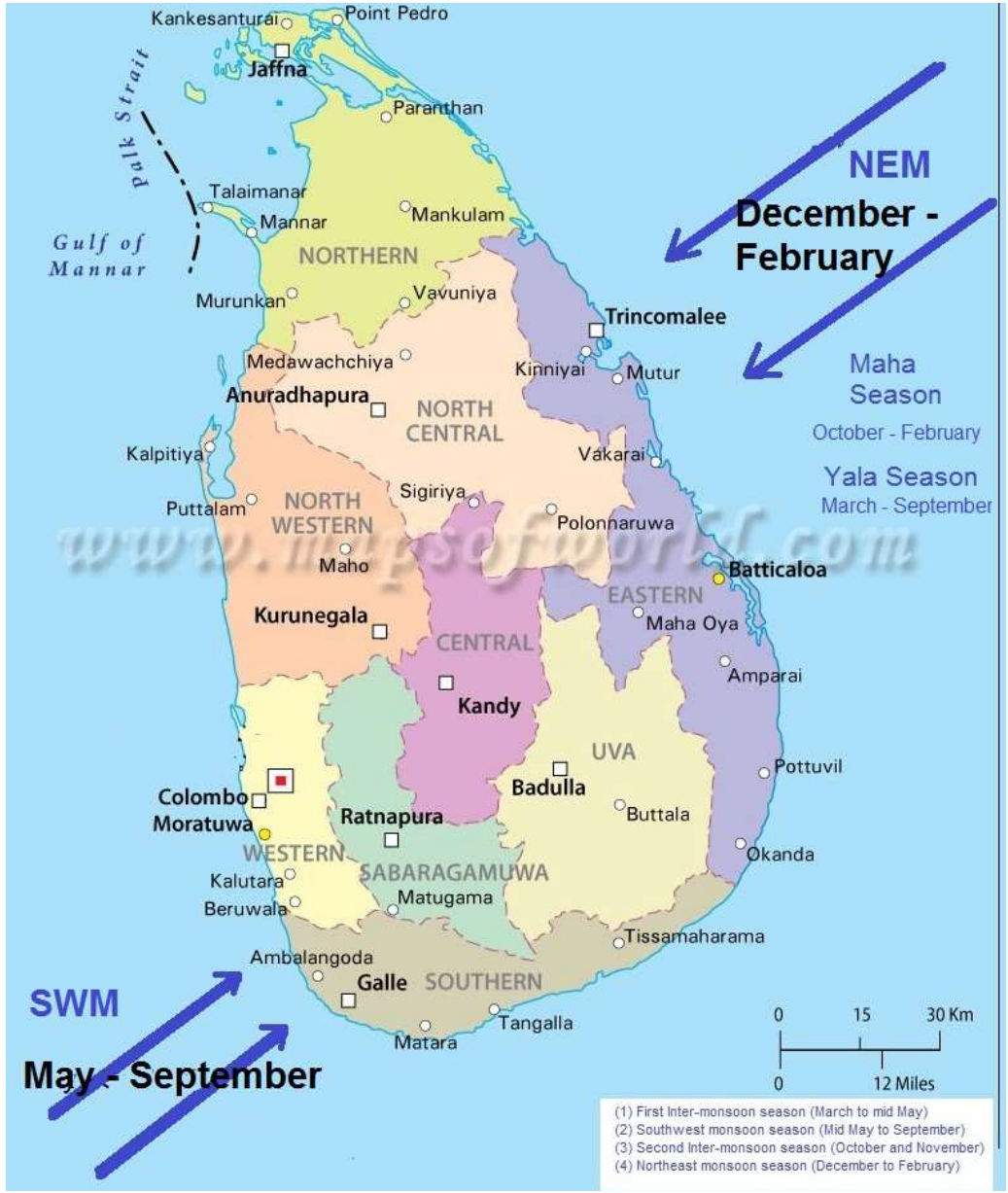
Water Resources Development Management

Contd…

Rainfall

Monsoons in Sri Lanka	
North East (NE) Monsoon	December – February
1st Inter Monsoon	March – April
South West (SW) Monsoon	May – September
2nd Inter Monsoon	October - November

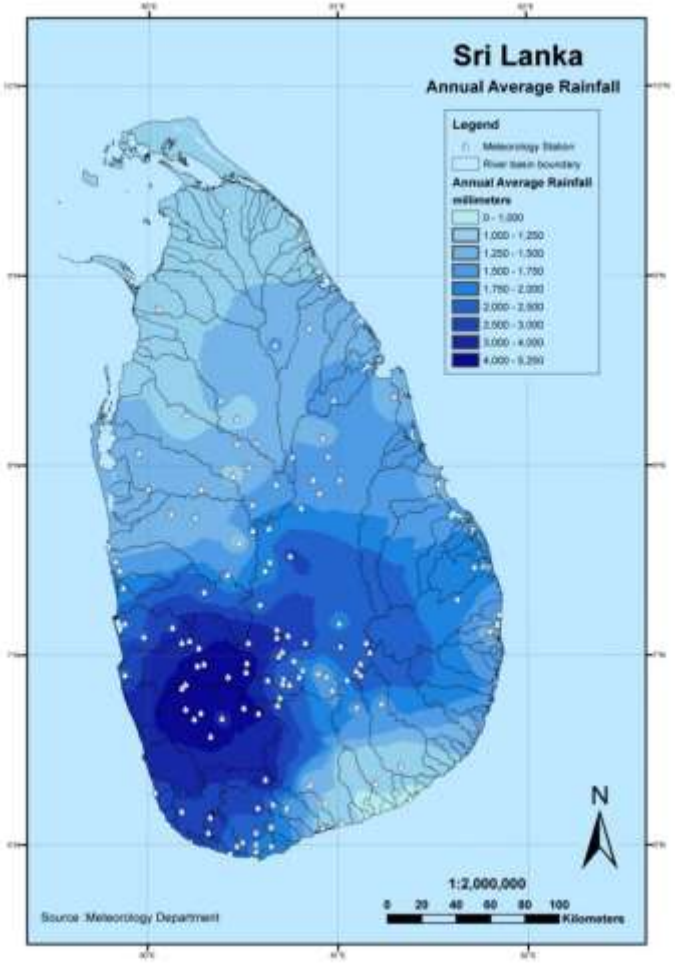
Annual Rain Fall : 750 – 6000 mm



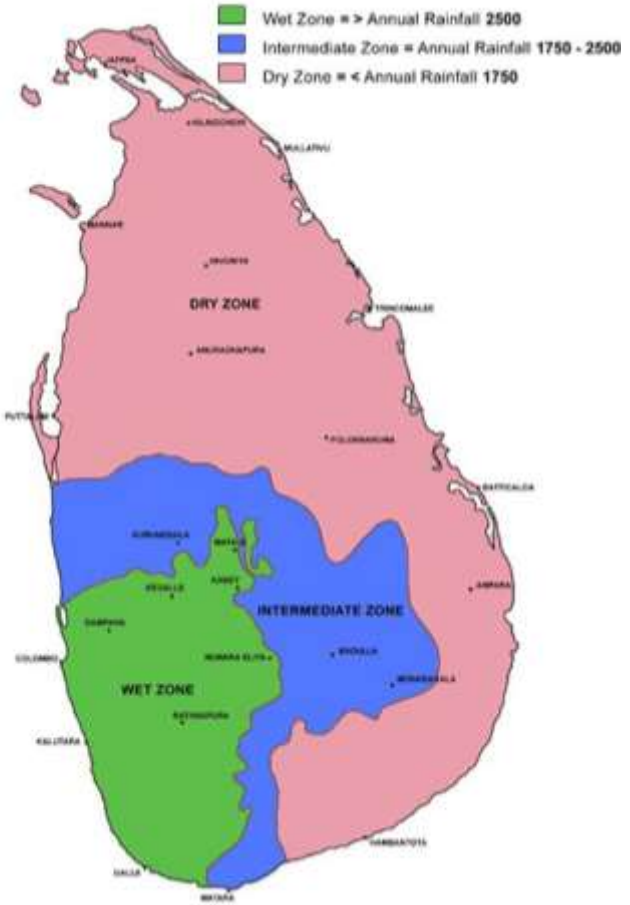
Water Resources Development Management

Contd…

Variation of annual average rainfall (period 1990-2009)



Variation of annual average rainfall in three zones

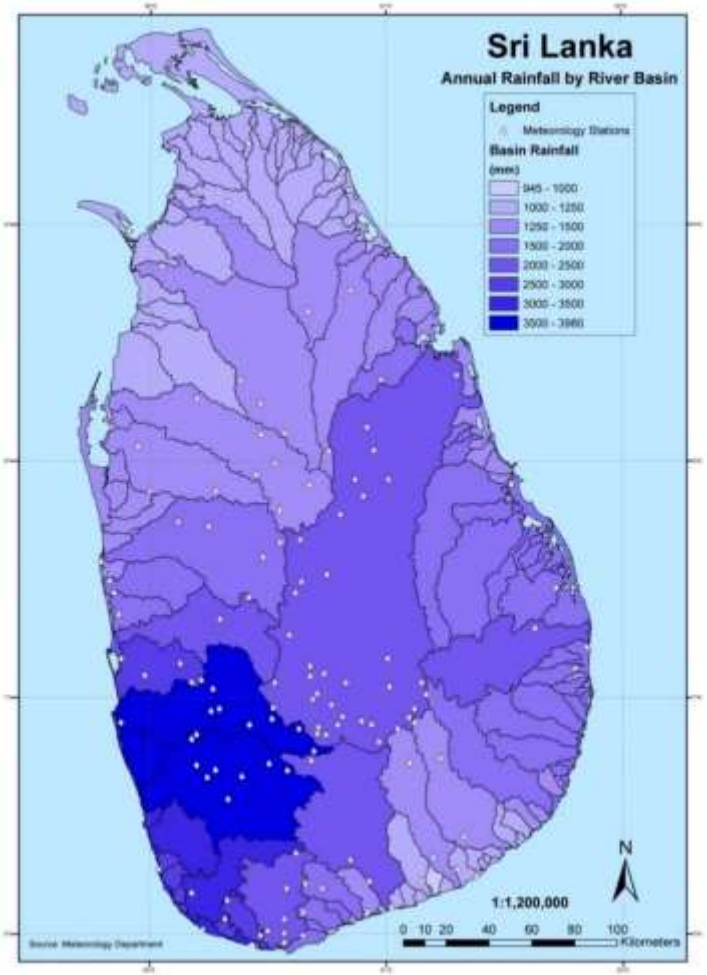


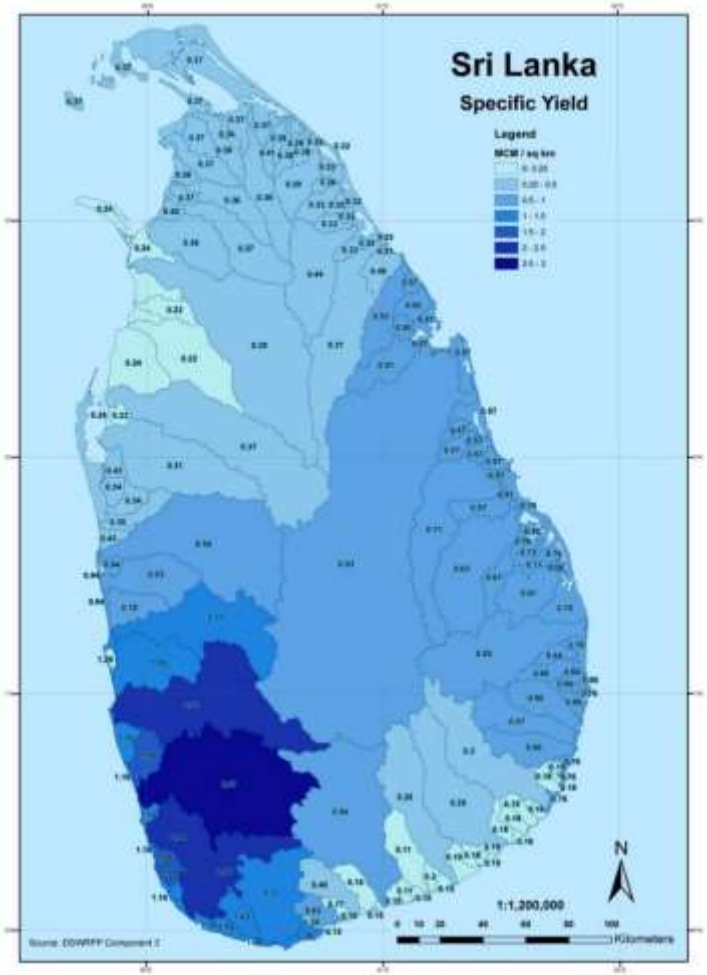
Source: Department of Census and statistics in Sri Lanka

Water Resources Development Management

Contd…

Rainfall distribution

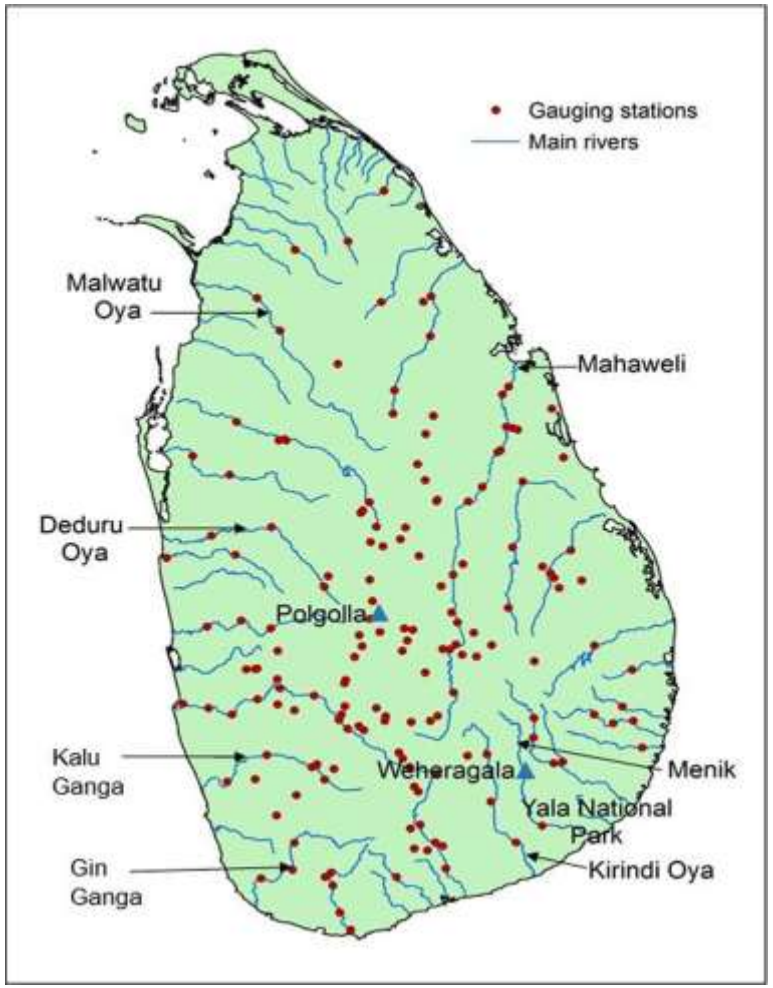


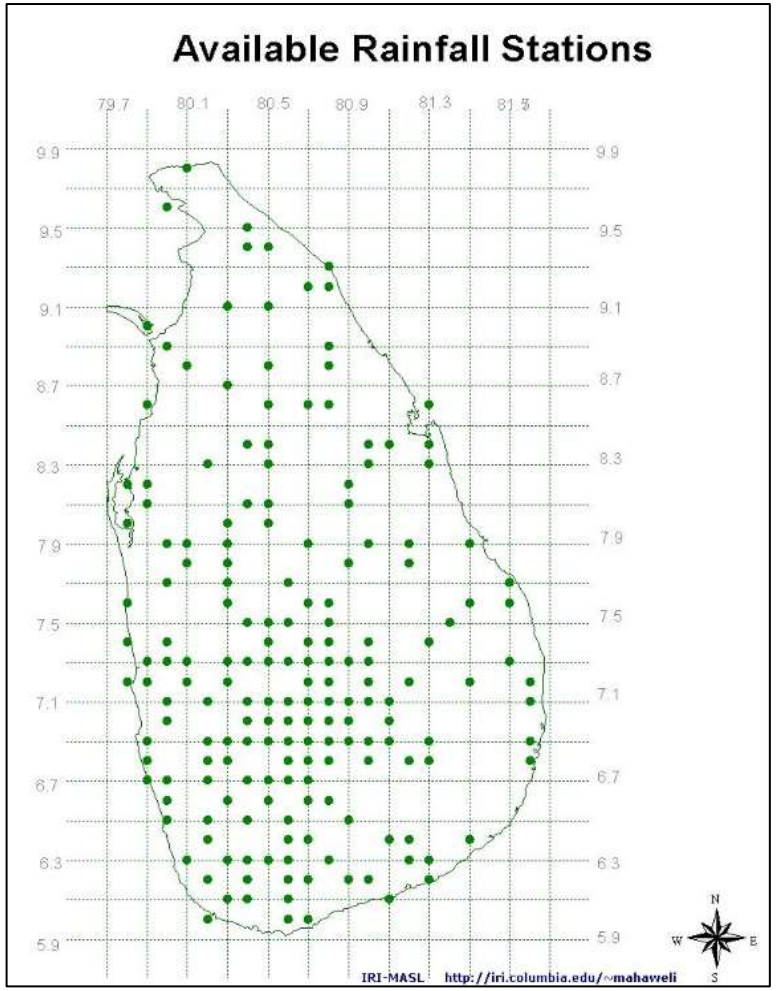


Water Resources Development Management

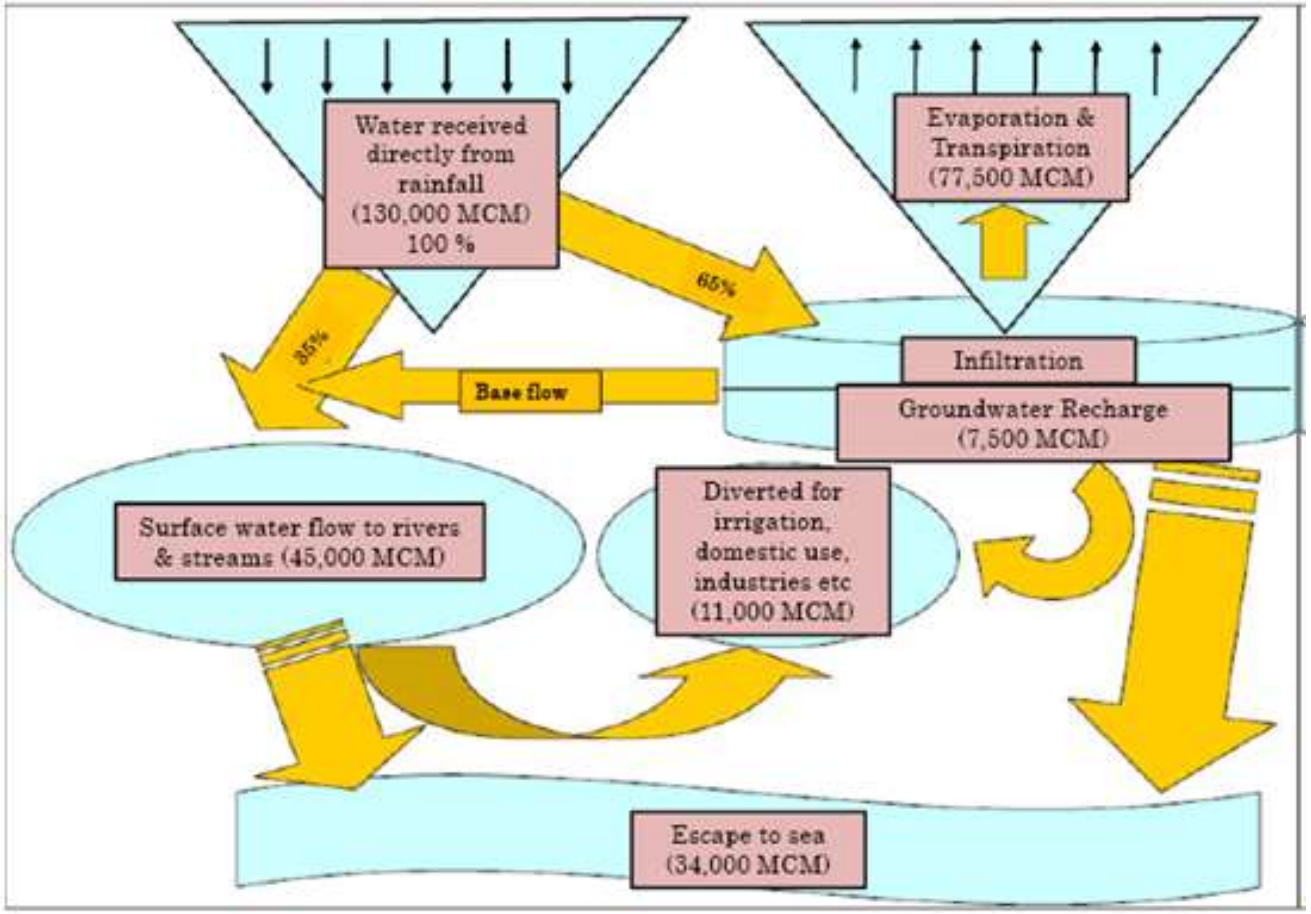
Contd…

Rainfall and runoff measurements





Generalized Water Balance



Source : http//www.getc.co.jp/wp-content/uploads/2010/12/101210 Seminar4.pdf

Water Resources Development Management

Contd…

Water Storages Reservoirs in Sri Lanka

Abaya Wewa (Abaya Tank)

- Built by the King Pandukabhaya
- Has a history of more than 2400 years-still in operation without any defects.
- The oldest tank in Sri Lanka
- Located in Anuradhapura
- Capacity 3.8 million cubic meters
- Surface area at FSL is 1930 Sqm

Water Management Era

- Pre-Colonial (6th century BC-16th century)
- Portuguese Colony (1505 - 1656 A D)
- Dutch Administration(1656- 1798 A D)
- British Colonial Period (1798-1948)
- Post independent Era (1948 – upto now)

Water Resources Development Management

Contd…

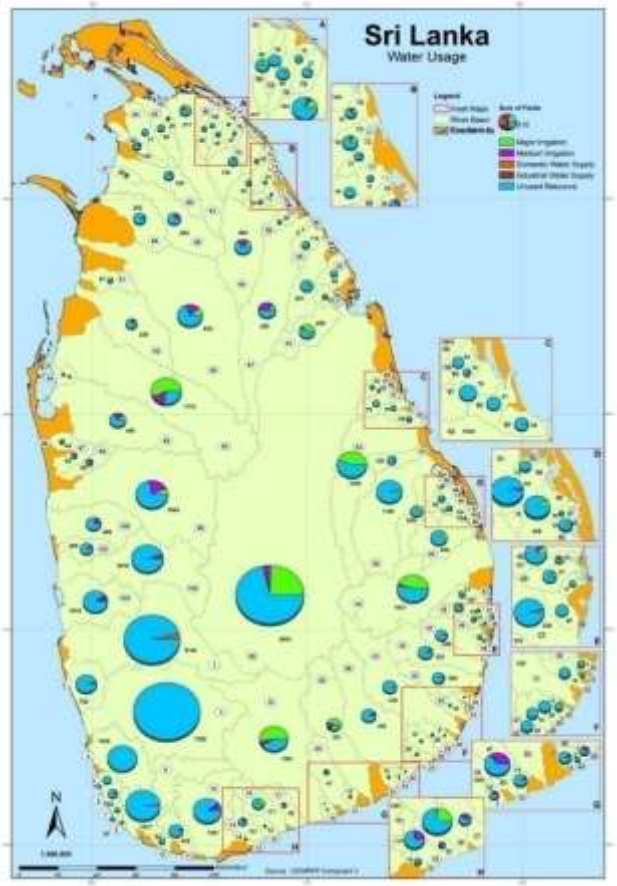
Water Storages Reservoirs in Sri Lanka

Major/Medium	No.
Earth	340
Concrete Gravity	10
Rock fill	04
Concrete Arch	01

Small Earth Embankments - Village Level - 12,000

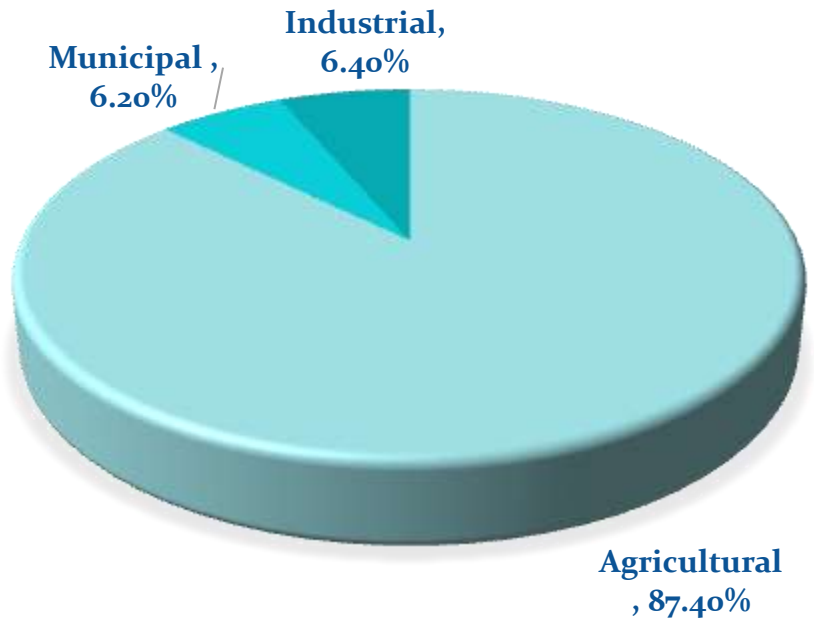
- Major reservoirs 73
- Medium scale reservoirs 160
- Total capacity 12,000 MCM
- No of irrigation schemes 354

Water usages by different sectors in Sri Lanka



Main water withdrawals

Agricultural - 11,310 million m^3 (87.4%)
Municipal - 805 million m^3 (6.2%)
Industrial - 831 million m^3 (6.4%)



Source: Aquastat FAO, 2005

Water Resources Development Management

Contd…

Key Organizations related to Water Resources Management in Sri Lanka

- Irrigation department
- Mahaweli authority
- National Water Supply & Drainage Board
- Water resources board
- Agrarian services department

Water Resources Development Management

Contd…

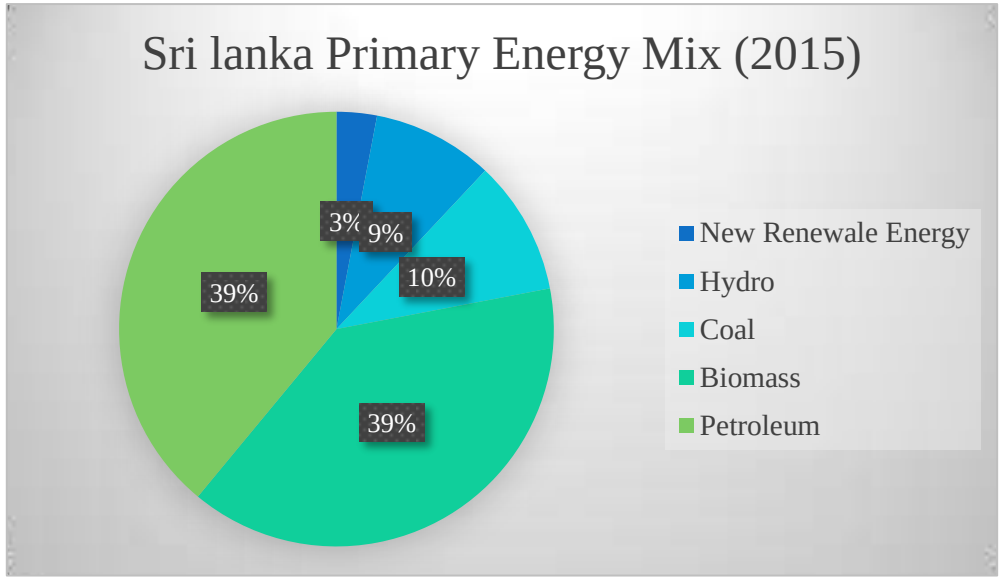
Challenges Faced……

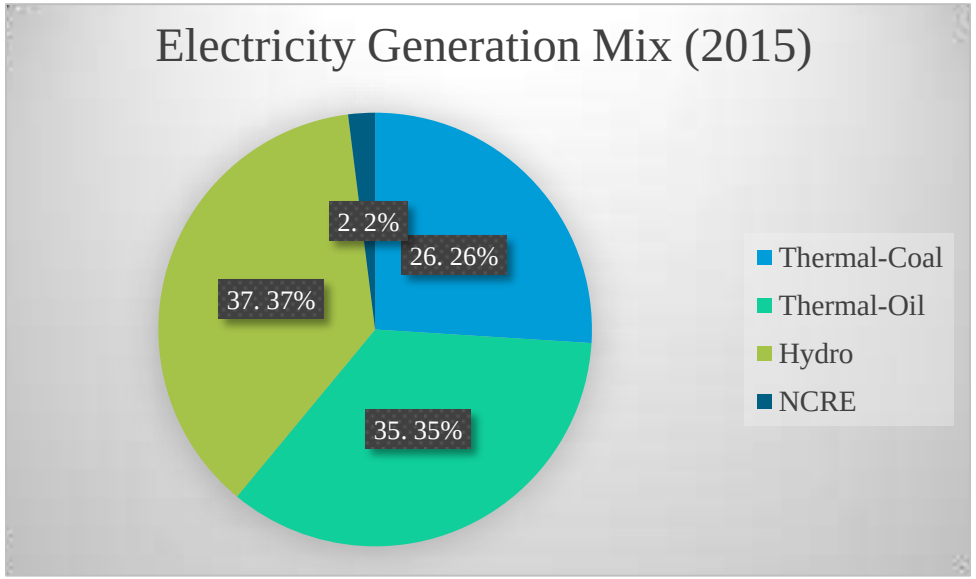
Flood

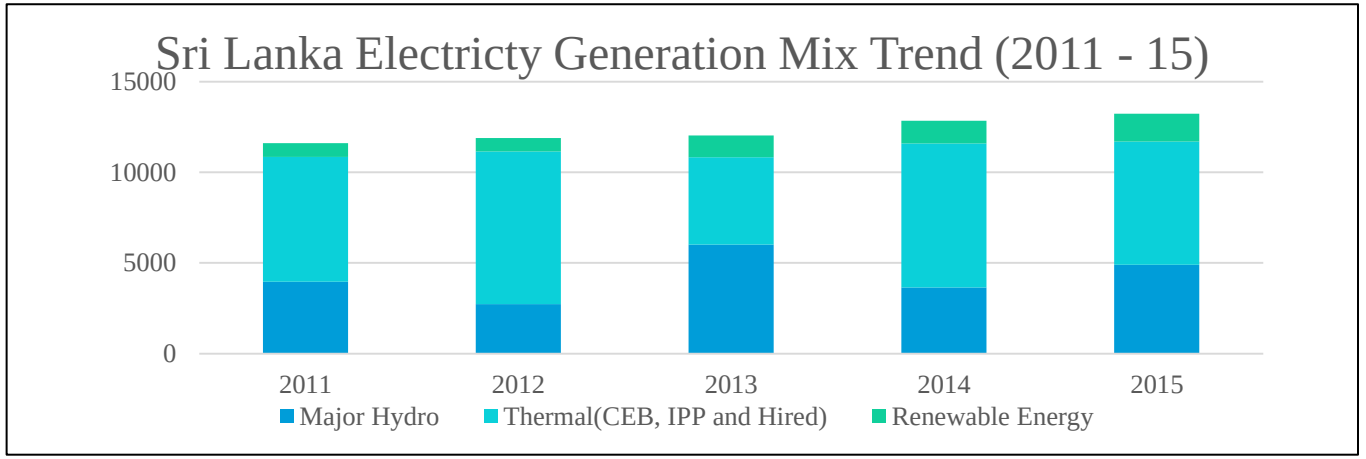
Drought

General condition of energy and power of the country Contd…

Energy Structure







General condition of energy and power of the country Contd…

Accessibility to Electricity

Current Development of Power Sector

Total Installed Capacity - 4,050 MW

- Thermal- Coal - 900 MW
- Thermal- Oil - 1,335 MW
- Hydro - 1,375 MW
- NCRE - 440 MW

Annual Demand 10,500 GWh

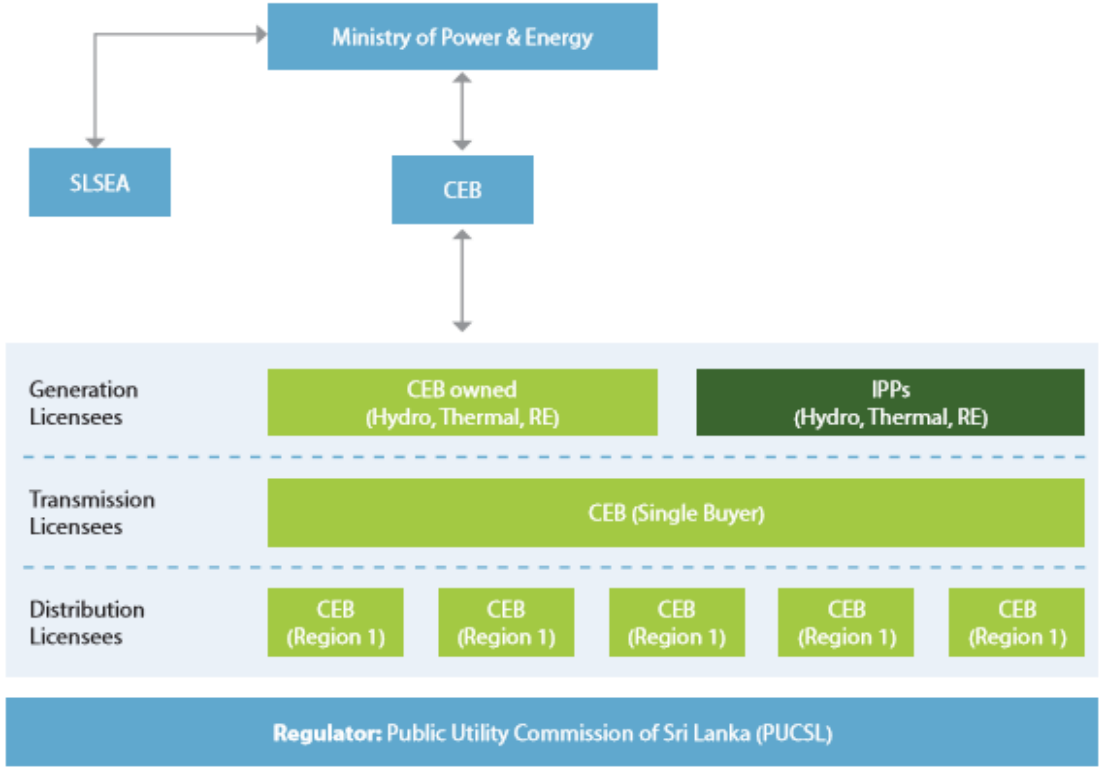
- Domestic - 38%
- Industrial - 39%
- Commercial - 20%
- Other - 3%

❑ Electrification: 98.4% of total population

General condition of energy and power of the country Contd…

Power and Energy Organization in Sri Lanka

* Ministry of Power & Energy
* Ceylon Electricity Board (CEB)
* Lanka Electricity Company (LECO)
* Independent Power Producers (IPP)
* Regulator: Public Utilities Commission of Sri Lanka (PUCSL)
* Sri Lanka Sustainable Energy Authority (SEA)



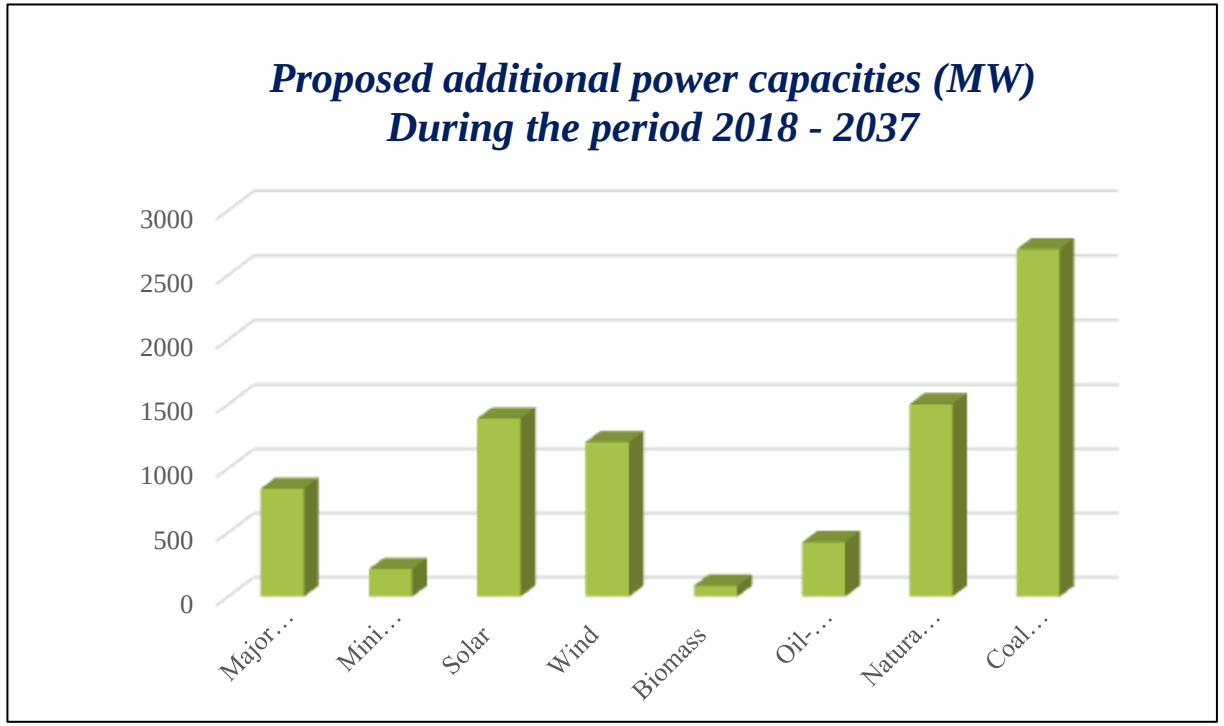
General condition of energy and power of the country Contd…

Energy Development Strategy

- Least cost generation option is coal fired power plants.
- Hence coal fired power plants will dominate SL power sector in the next 20 years.
- By 2025, expected increase in thermal share would be 70% which will mainly be covered by coal plants.

General condition of energy and power of the country Contd…

Type	MW
Major Hydro	842
Mini Hydro	215
Solar	1389
Wind	1205
Biomass	85
Oil-based power	425
Natural gas	1500
Coal power	2700



Proposed additional capacity 8361 MW

Condition of hydropower development

Contd…

Hydropower Classification in Sri Lanka

- Major hydro - >10 MW
- Mini hydro - 10 MW > Mini > 1 MW
- Micro hydro - 1MW > micro > 1 KW
- Pico hydro - less than 1 KW

Small Hydropower

Condition of hydropower development

Contd…

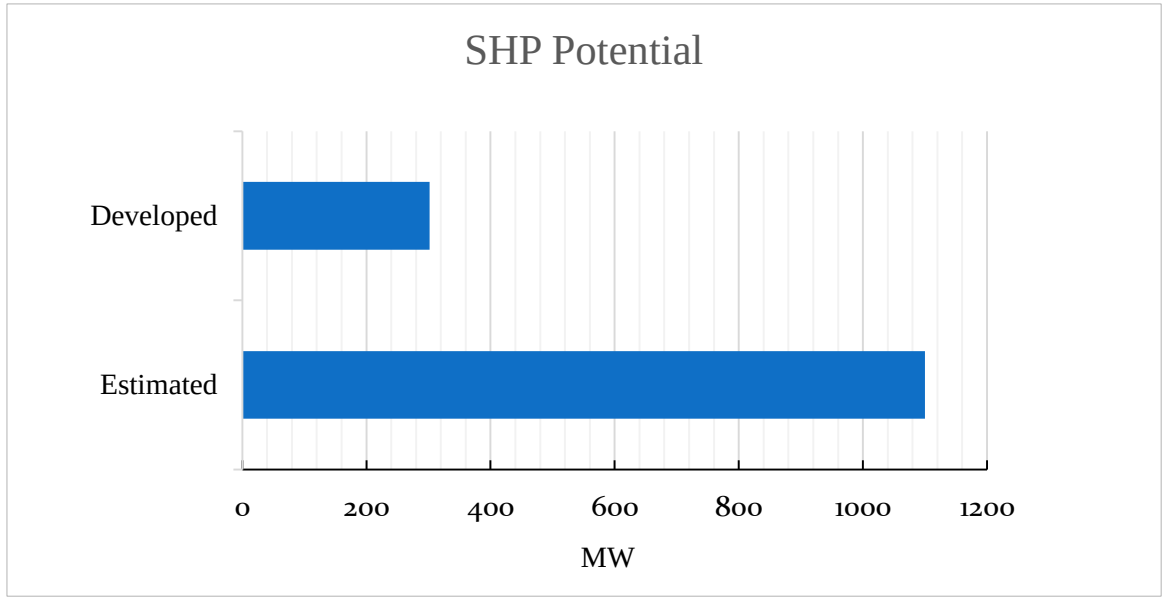
Already installed capacities and potential hydropower capacities

- Hydro Energy: 2,423 MW (Sri Lanka has harnessed more than 45% of its total hydro power potential. It has been identified that the balance available potential is approximately 1268 MW.
- Wind Energy: 20,000 MW (5 MW/km^2, 6% of the land area is windy area)
- Solar Energy: (2/3 of the land area have solar radiation of 4.0 - 4.5 kWh/m^2/day)
- Liquid fuel and LNG: under exploration
- Crude oil/ petroleum and Coal: Import from Middle East Countries, Indonesia, South Africa and Australia

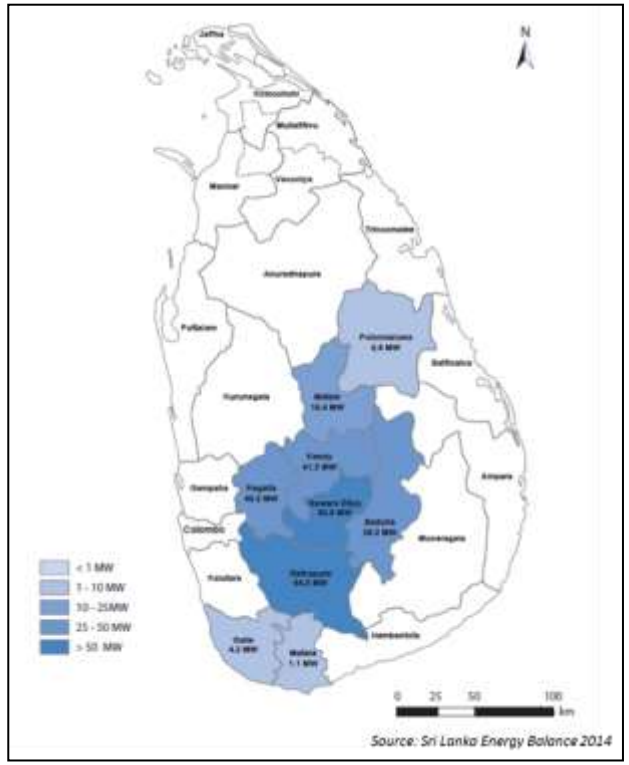
Condition of hydropower development

Contd…

Presently, over 15 private sector companies are engaged in small hydropower projects and supply 300 MW of power generated in 150 power plants to the national grid amounts to 17.5% of hydropower generation in the country.



45% of potential installed

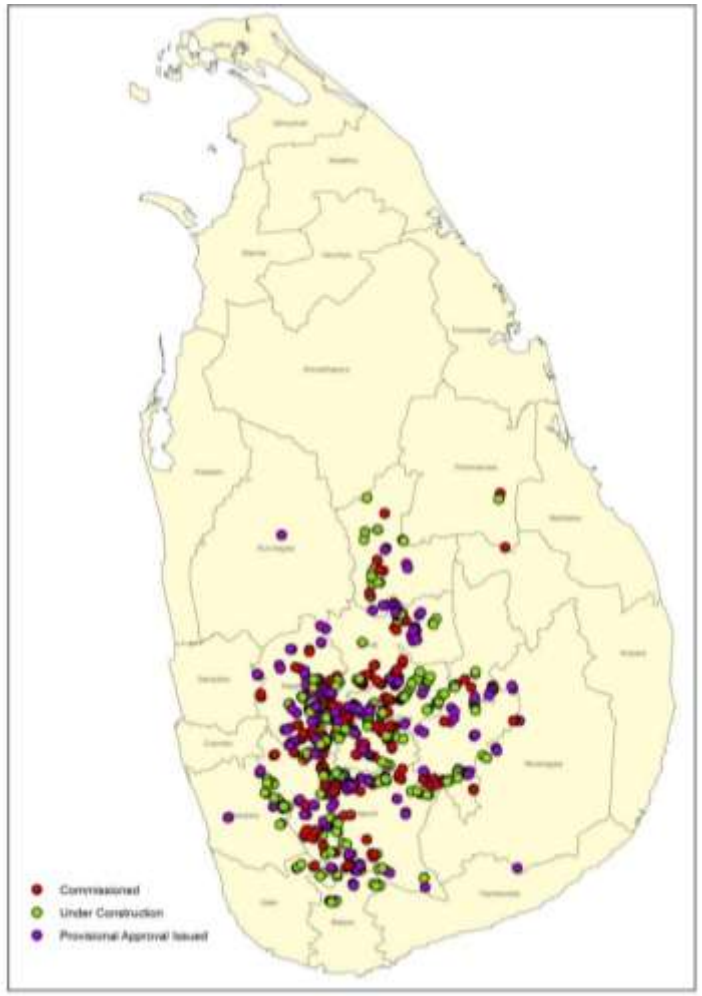


Condition of hydropower development

Contd…

SHP development in Sri Lanka 2016

Status	No. of Projects	Capacity MW
Commissioned	147	300
Under Construction	110	195
Provisional Approval Issued	70	100
Processing Stage	402	475
Total	**729**	**1070**

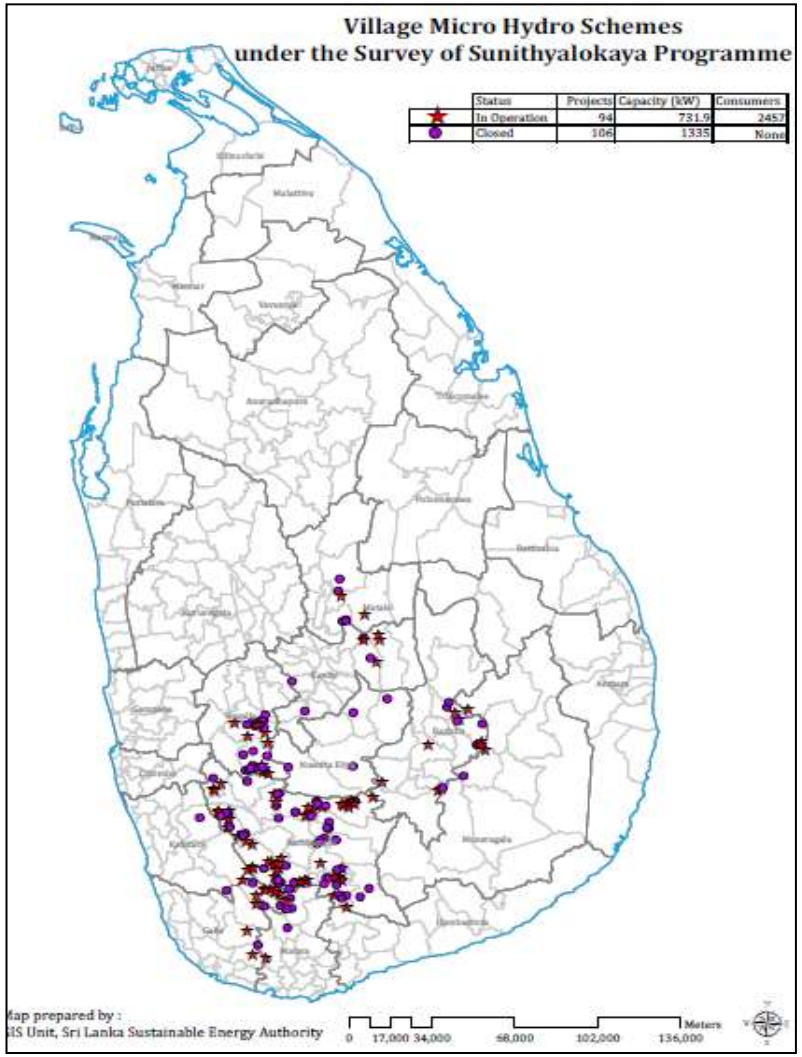


Condition of hydropower development

Contd…

Off-Grid Micro Hydro Development

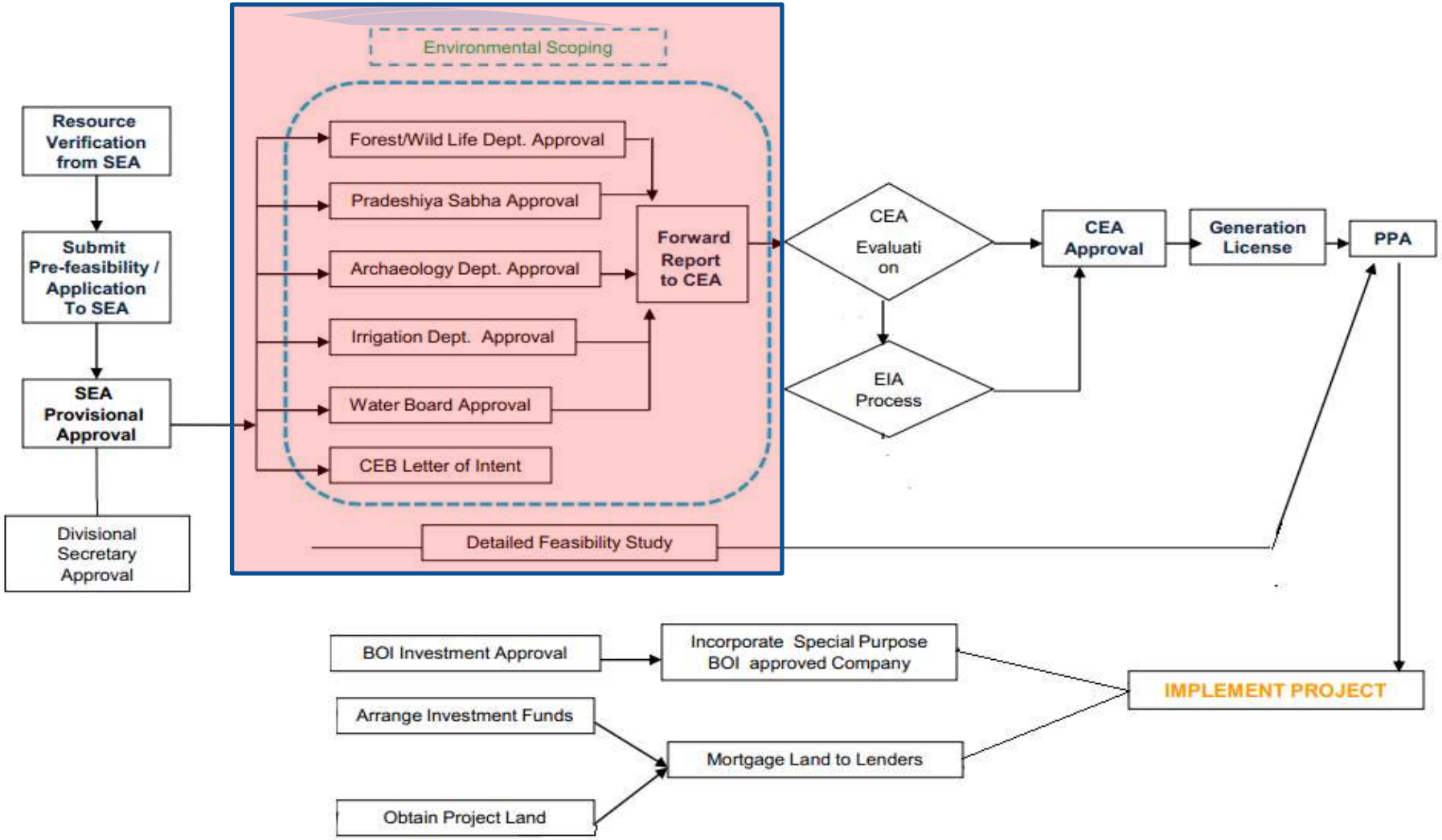
	Status	Projects	Capacity (kW)	Consumers
★	In Operation	94	731.9	2457
●	Closed	106	1335	None



Condition of hydropower development

Contd…

SHP Development process in Sri Lanka

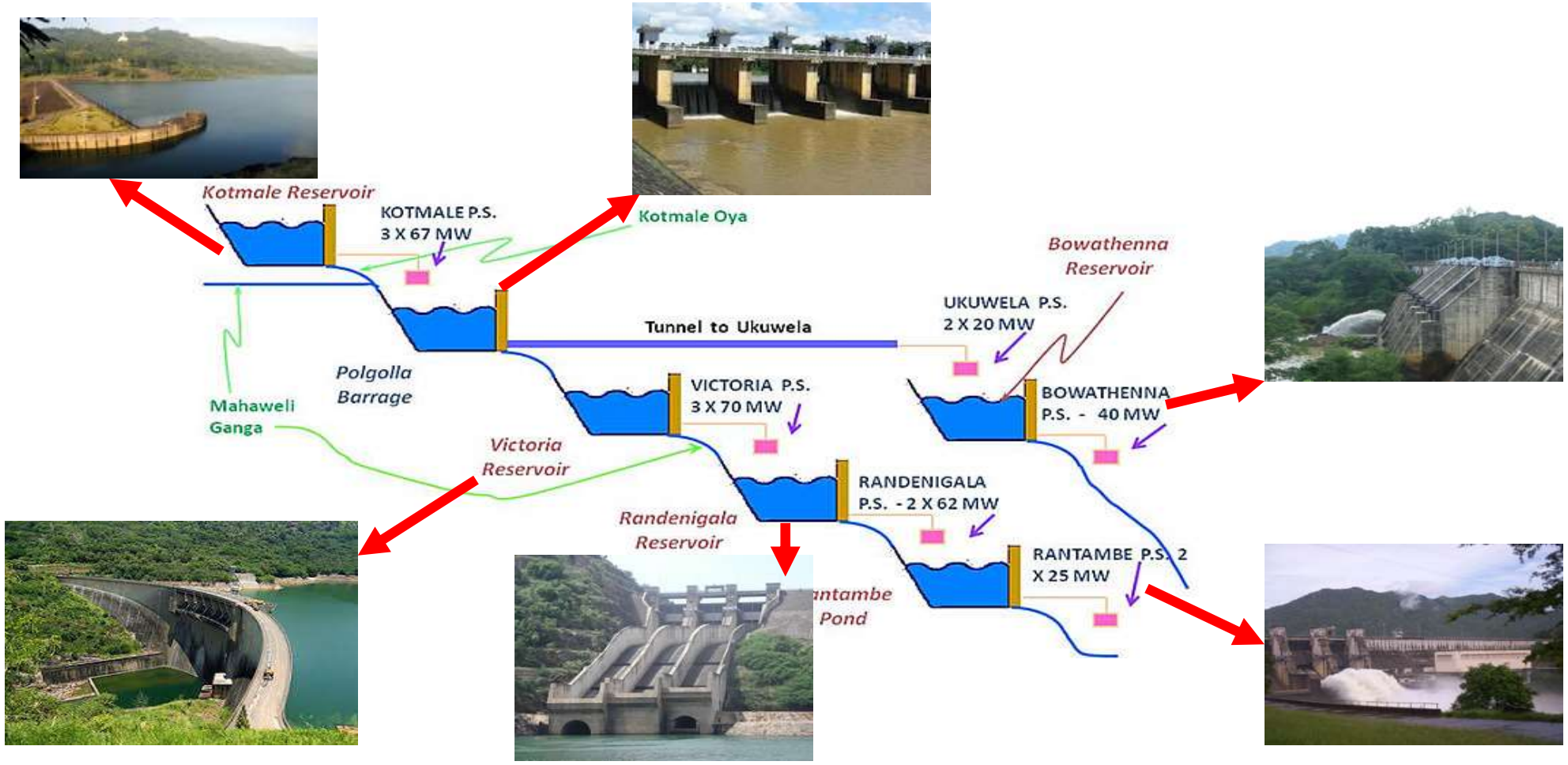


Some of the multipurpose development projects

Contd…

Mahaweli Project

- Total installed Capacity – 660 MW



Some of the multipurpose development projects

Contd…

Moragahakanda Project

- *Reservoir capacity – 560 MCM*
- *Power Capacity – 25 MW*

Dam – 170 MCM

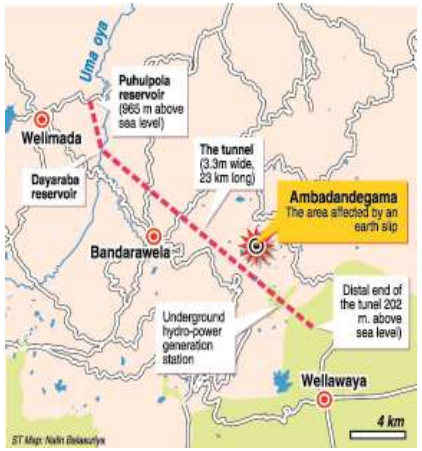
Power House

Some of the multipurpose development projects

Contd…

Uma Oya (under construction)

- Puhulpola reservoir capacity - 80 MCM
- Diaraba reservoir capacity - 25 MCM
- Power - 120 MW



Power shaft

Tunnel

Boring Tunnel

Under ground power house

Puhulpola Dam

Diaraba Dam

Some of the multipurpose development projects

Contd…

Yan Oya Reservoir project (on going)

- ✓ Capacity 160 MCM
- ✓ Dam Length 2.35 km (Saddle Dam 3.59 km)
- ✓ Canal length 34 kms
- ✓ New Irrigable land 5700 Ha

Some of the SHP projects

Contd…

Name : Kiriwana Eliya
Capacity : 4.56 MW
Net head : 200 m
Energy: 16 GWh

Name : Erathna SHP
Capacity : 10 MW
Net head : 426 m
Energy: 40 GWh

Name : Katapola Village
Capacity : 280 W
Net head : 19 m
Flow Rate : 3 l/s

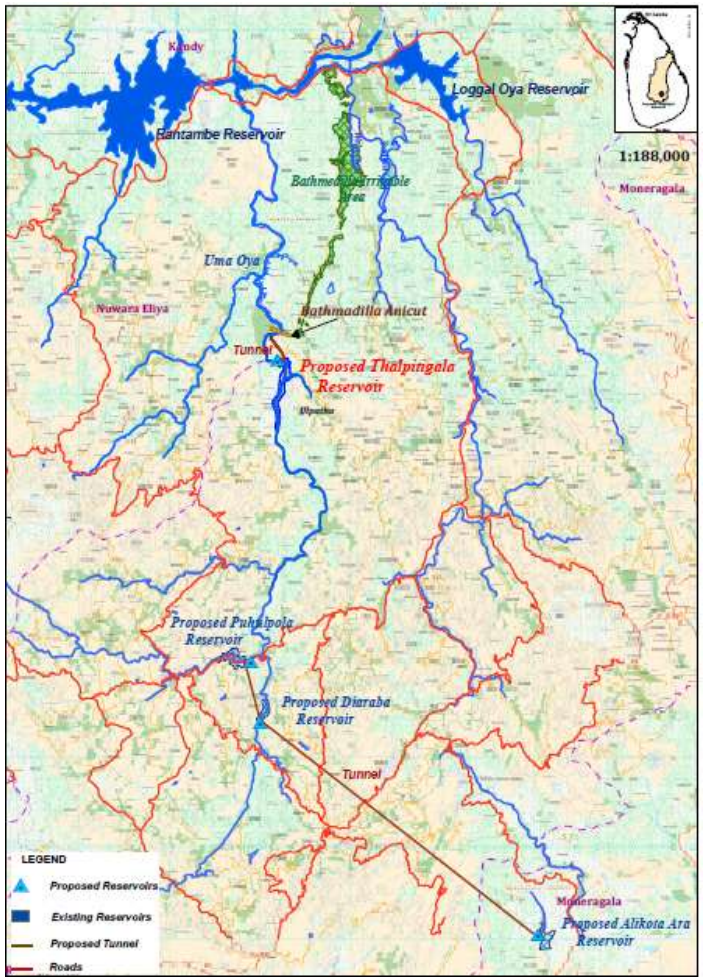
Hydropower Projects to be constructed with installed capacity under 50 MW

- ✓ Thalpitigala (55 MW - Sinohydro)
- ✓ Kumbukkan Oya (4 MW – CHMC)
- ✓ Mundeni Aru (4 MW)
- ✓ Broadlands (35 MW to be completed by 2019)
- ✓ Moregolla (30MW to be completed by 2021)
- ✓ Gin Gaga (30 MW in planning stage)
- ✓ Sitawaka Gaga (20 MW in planning stage)
- ✓ Large pump storage plants (300 – 500 MW in planning stage)

Projects to be constructed….

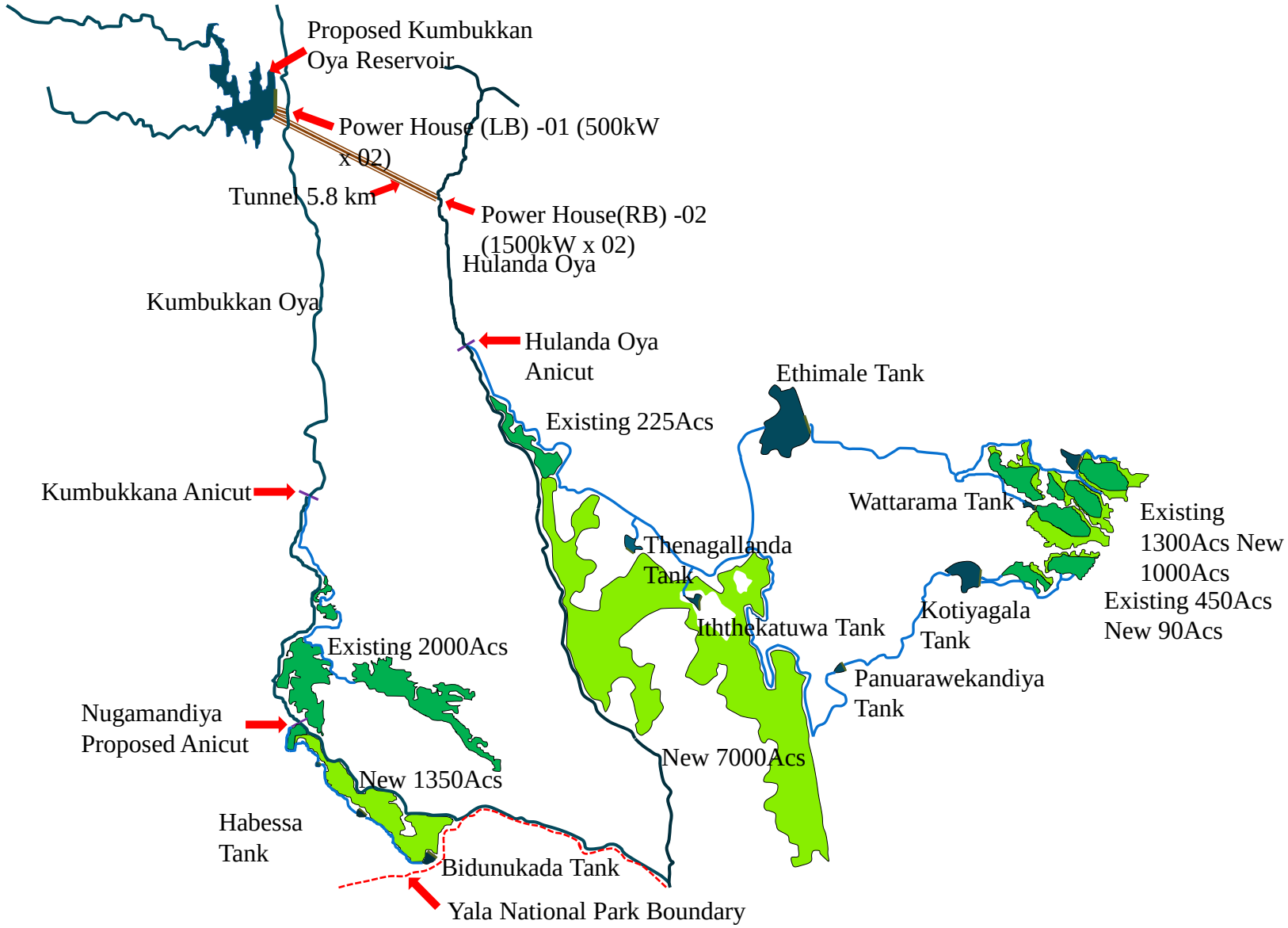
Contd…

Proposed Thalpitigala Reservoir Project (55 MW)



Proposed Kumbukkan Oya Reservoir Project (4 MW)

Contd…



Proposed Mundeni Aru Basin Development Project (2 MW)

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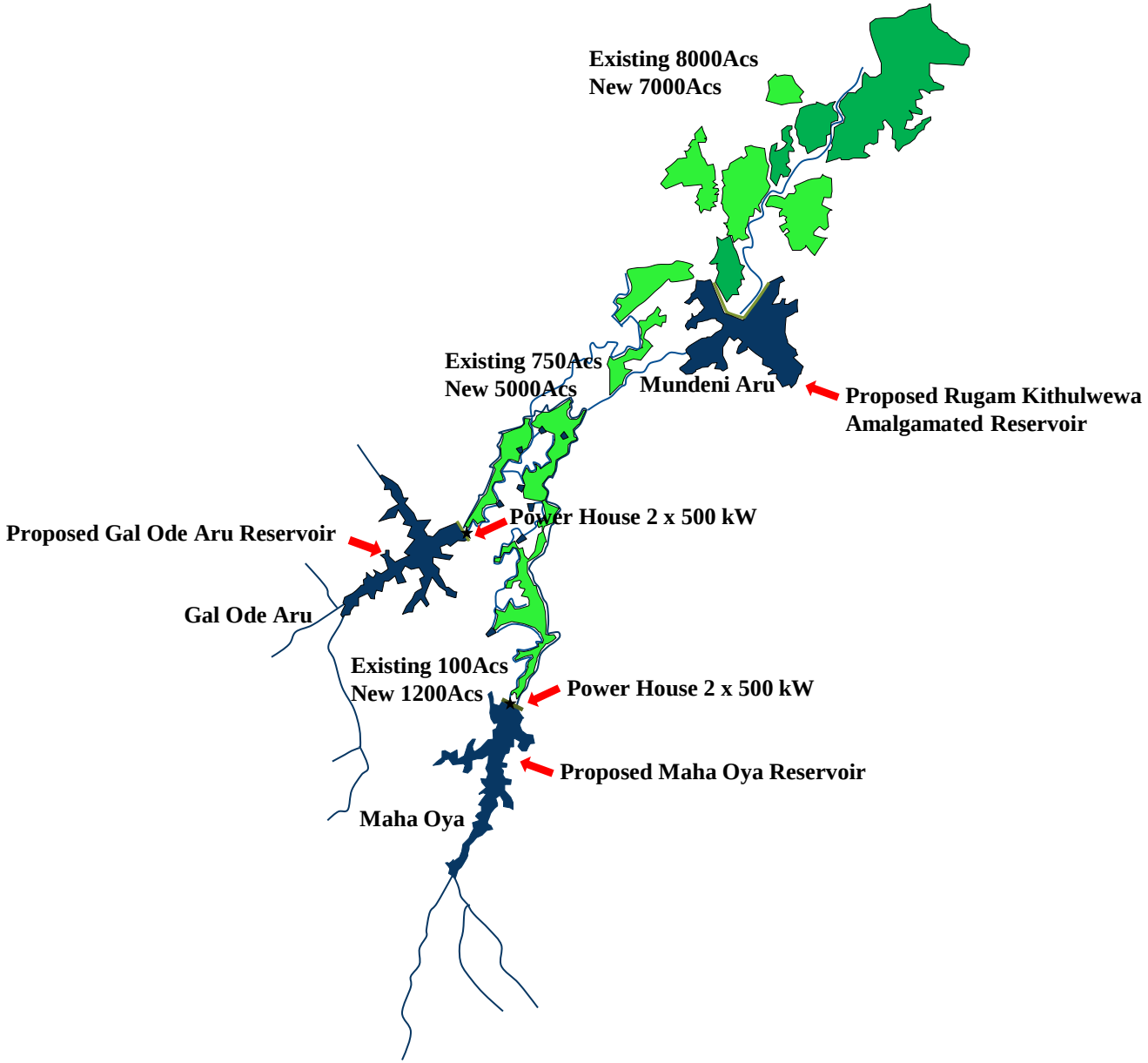

Difficulties and Barriers in Water Resources Management and Small Hydropower Development

Key Challenges faced by the Sri Lankan Power Sector

- A large amount of investment is required for infrastructure development in the power sector (generation, transmission and distribution).
- Non-availability of proper incentives to develop RE based capacity.
- Currently, the high cost of electricity from RE sources is a deterrent to development of new RE capacity.
- Lack of local research and development to promote local capacity development:
- As Sri Lanka’s electricity sector is largely dependent on hydro plants, any variability in the monsoon pattern hits the sector hard.
- Social and environmental issues.

Difficulties and Barriers in Water Resources Management and Small Hydropower Development

Contd…

Key Challenges faced in managing water resources

- Depletion and degradation of the resource caused by various anthropogenic activities. Surface inland waters in urban areas are polluted heavily with domestic sewage and industrial effluents, and in rural areas with agricultural runoff.
- Difficulty for water sector institutions to manage water resources within the existing institutional and legal framework.
- Lack of coordination among the water sector institutions having the mandate.
- Too many institutions having legal powers to manage water resources.
- Impacts of climate change.


ආයුබෝවන්!
(Wish you a Healthy and Long Life)
THANK YOU….
谢谢….