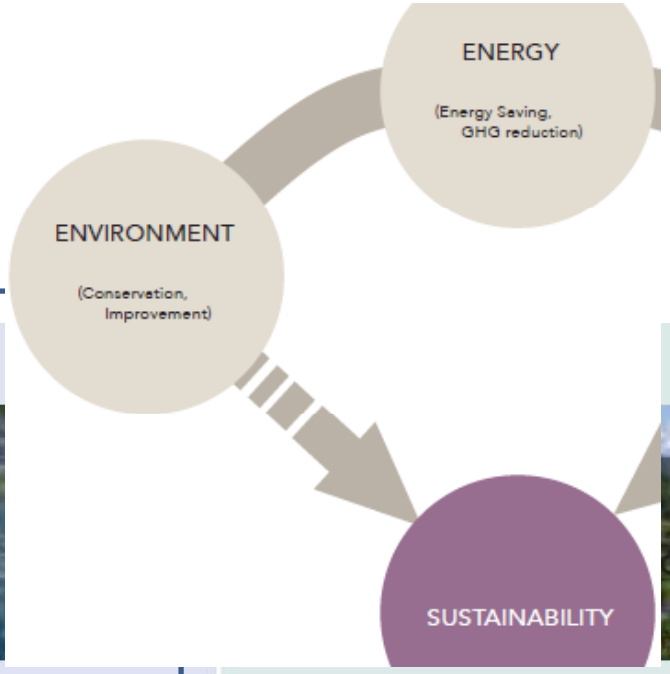
Some steps for sustainable development – Sri Lanka

S.B.Weerakoon
Professor, Department of Civil Engineering
University of Peradeniya

Kick-off Meeting:
AP Regional Initiatives on 3E Nexus for Sustainable Development
24-25 February 2014, Male

3E NEXUS INITIATIVES

WORKSHOP THEME - ENVIRONMENT



cy, saving and conservation, rgy, Storage batteries, Smart ommunity, High-efficiency rgy management, Energy ump, combined heat and wer generation, Energy from wer generation, Ocean n, Fuel for transportation, oduction, Fossil fuel clean technology, Clean coal n-fossil fuel, Energy industry, Electric power, control and management,

ENVIRONMENT

Environment protection, Solid Waste Management and Utilization, Global climate change, Urban Development, Rivers, lakes, seas and oceans, Environmental Laws and Polices, Advances in Natural Resource Utilization and Conservation, Carbon Emission Reduction Strategies, Air Pollution Measurement and Control Technologies, Emerging Pollutant Removal from Water and Wastewater, Novel Wastewater Treatment Technologies, Noise Pollution Reduction Techniques, Quality of water, Groundwater flow engineering, Environmental modeling.

Endangered Species Preser Biodiversity as a Resource, Dynamics, Role of Humans Role of Ecology in Urban D Biodiversity and Biological Health Risk Assessment, Ec Sustainability, Effects of Po Ecosystem, Loss in Biodiver Anthropogenic Activities, P cultural heritage

Some actions for sustainable development – Government initiatives

Ministry of Environment and Renewable Energy has the mandate for policy developments for management of environment and natural resources

Environmental protection
Energy saving
Ecosystem conservation

→ Low carbon society

While facilitating country progressing towards:

High standard of living (poverty alleviation)
Food, energy, water security
Disaster risk reduction (safety)

About Us

The Ministry of Environment and Renewable Energy of Sri Lanka remains committed for the management of the environment and natural resources of the country, maintaining the equilibrium between the trends in rapid economic development and use of natural resource base.

Social and economic behavior of the increasing human population has put a major threat in achieving these objectives. The ministry has framed key policies for adoption in management of environment and natural resources of the country. These policies are implemented with the participation of stakeholders including government, agencies, NGO's and communities.

Our Vision

A healthy and pleasant environment sustaining nature for the well being of the people and the economy.

Our Mission

Provide Leadership to manage the environment and natural resources in order to ensure national commitment for sustainable development for the benefit of the present and future generation.

(National Environmental Act No: 47 of 1980 amended by Acts No 56 of 1988 and No 53 of 2000)

Issues the Environmental Protection License (EPL)

- a regulatory/legal tool

-To prevent or minimize the release of discharges and emissions into the environment. To ensure cleaner production, waste minimization, use new technologies for pollution abatement, efficient resource utilization/ protection, etc.

Introduce regulations for:

Wastewater discharge, solid waste disposal

Noise and vibration control,

Air pollution control, vehicle emission control,..

Climate Change Secretariat Sri Lanka

Ministry of Environment and Renewable Energy

- CCD-Home
- DNA
- KYOTO PROTOCOL
- CDM
- History&Background
- Carbon Market
- Post Kyoto
- National Policy
- Country Portfolio
- UNFCCC
- Library
- Event Calendar
- News
- FAQs
- Site Map

Clean Development Mechanism

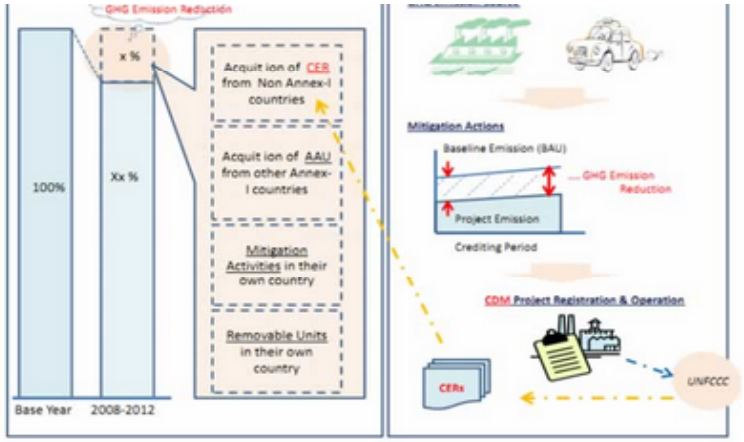
Authority to approve and authors participation by entities in CDM project
Evaluation & Approval of CDM project,
Capacity Development for CDM Project Development and CDM Market.

Clean Development Mechanisms or so called CDM is the o
in Kyoto Protocol under United Nation Frameworks
assisting Annex I parties to archive their committed amou
hand, contribution for sustainable development of Non Ann

Description in the Kyoto Protocol

In the Article 12, CDM is defined as; CDM Activities shall be hosted by Non Annex I parties which ratified the Kyoto Protocol, validated byDesignated Operational Entity (hereinafter referred as "DOE") and registered by CDM Executive Board (hereinafter referred as "EB")after review by a Registration and Institution Board.

Designated National Authority.(DNA)



Once any CDM project(s) registered under UNFCCC and completed verificationconducted by DOE, The EB issue Certified Emission Reduction (CER) for quantified emission reduction from the project(s). Unit of CER is 1Co2t and all CER are numbered. CER is tradable among the Annex I Partiesand public & private entities be authorized by the Annex I Parties and can be used to meet with their committed legally binding emission reduction quantity.

AAU (Assigen Amount Unit)

units issued by Parties to the Kyoto Protocol into their national registry up to their assigned amount, calculated by reference to their base year emissions and their quantified emission limitation and reduction commitment (expressed as a percentage).

Removal Units

Removal units (RMUs) are issued by Parties to the Kyoto Protocol in respect of net removals by sinks from activities covered by Article 3(3) and Article 3(4) of the Kyoto Protocol (in the land use, land use change and forestry sector).

Baseline Emission (Baseline Scenario)

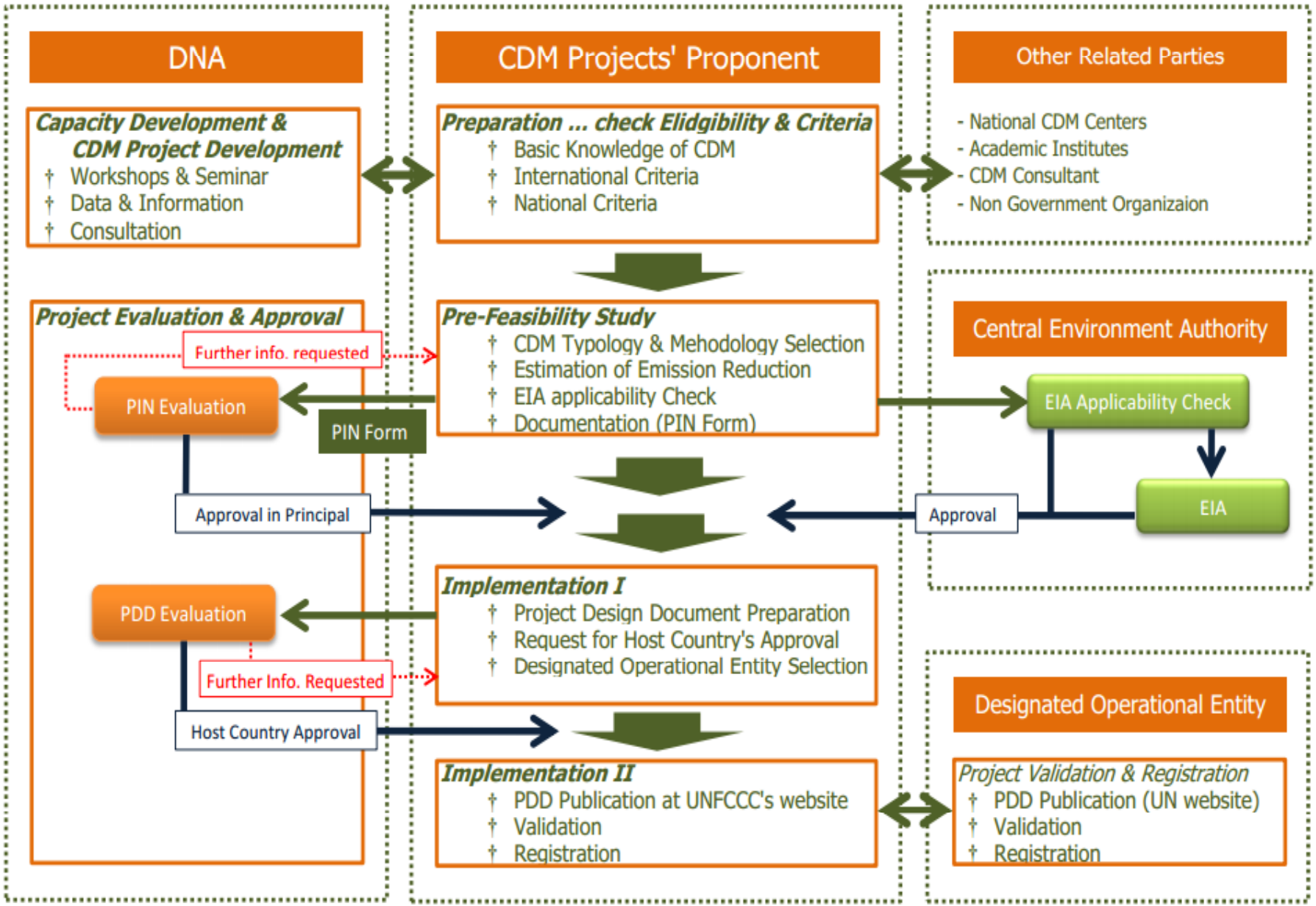
the continuation of current emission levels in the absence of the CDM project activity

List of Registered Project

Status	Title	Participants	Other Parties	Sectors	Activity Sale	Methodologies	Amount of Reduction *	Registration
Registered	10 MW Biomass Power Generation Project	Tokyo Cement Company (Lanka)Ltd.	Japan Carbon Finance Ltd. (Japan)	Energy (renewable - / non-renewable sources)	SMALL	AMS-I.D. ver. 13	43 800	10/26/2009
Registered	Coconut shell charcoaling and power generation at Badalgama, Sri Lanka	Recogen Limited	Japan Carbon Finance, Ltd. (Japan)	Energy (renewable - / non-renewable sources) , Manufacturing	SMALL	AMS-III.K. ver. 3 AMS-I.D. ver. 13	43 265	3/28/2009
Registered	Sanquhar and Delta Small Hydro Power Projects	Hydro Power Free Lanka (Pvt) Ltd	VOLTALIA (Switzerland)	Energy (renewable - / non-renewable sources)	SMALL	AMS-I.D. ver. 9	5 489	12/11/2006
Registered	Hapugastenne and Hulu Ganga Small Hydropower Projects.	Eco Power (Private) Ltd. (EPL)	IFC Netherlands Carbon Facility (INCAF) (Netherlands)	Energy (renewable - / non-renewable sources)	SMALL	AMS-I.D. ver. 5	44 842	10/30/2005
Registered	Small Hydropower Projects at Alupola and Badulu Oya.	Hydro Power Free Lanka (Pvt) Ltd	IFC Netherlands Carbon Facility (INCAF) (Netherlands)	Energy (renewable - / non-renewable sources)	SMALL	AMS-I.D. ver. 5	25 109	10/30/2005
Registered	Magal Ganga Small Hydropower Project	Eco Power (Private) Ltd. (EPL)	IFC Netherlands Carbon Facility (INCAF) (Netherlands)	Energy (renewable - / non-renewable sources)	SMALL	AMS-I.D. ver. 5	34 179	10/30/2005
Rgistered	Adavikanda, Kuruwita Division Mini Hydro Power Project	Alternate Power Systems (Pvt.) Ltd.	Mitsubishi UFJ Securities Co., Ltd. (Japan)	Energy (renewable - / non-renewable sources)	SMALL	AMS-I.D. ver. 13	13 484	

Very few! ??

Flowchart for CDM Project Development



SRI LANKA
SUSTAINABLE ENERGY AUTHORITY

සිංහල | தமிழ் | ENGLISH

SEARCH

Energy is Life
make the most of it

RENEWABLE ENERGY

INTRODUCTION TO RENEWABLE ENERGY

- What's Renewable Energy
- RE Resources in Sri Lanka
- Policy Targets
- Renewable Energy Forcast
  - Grid
  - Off-Grid

INTRODUCTION TO RENEWABLE ENERGY

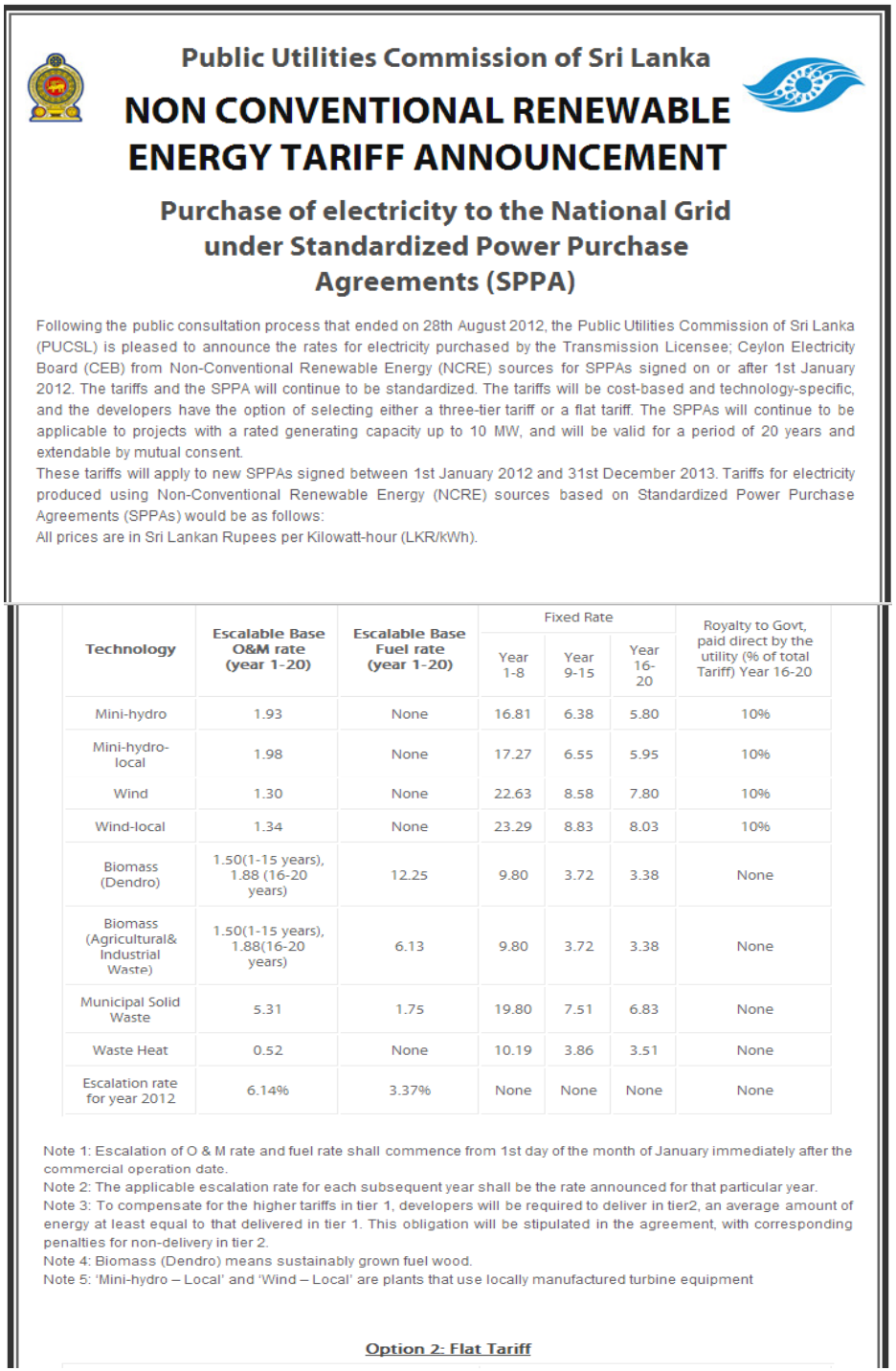
WHAT IS RENEWABLE ENERGY?

A natural resource is called an energy resource if it can be converted to a usable form of energy. An energy resource is known as an 'indigenous energy resource' when it originates within the country. It is known as non-indigenous if it originates outside the country. Renewable Energy is a form of energy resource that is replaced by a natural process at a rate that is equal to or faster than the rate at which that resource is being consumed.

SEA-
Issues the Energy Permit for utilization of Renewable energy resources for generation,
the facilitator for implementation of renewable energy projects

National Energy Policy of Sri Lanka –

The Development Framework of the Government of Sri Lanka' requires 20% of electricity generation from NRE by 2020, with the target of 10% met by end 2016.



Public Utilities Commission of Sri Lanka

NON CONVENTIONAL RENEWABLE ENERGY TARIFF ANNOUNCEMENT

Purchase of electricity to the National Grid under Standardized Power Purchase Agreements (SPPA)

Following the public consultation process that ended on 28th August 2012, the Public Utilities Commission of Sri Lanka (PUCSL) is pleased to announce the rates for electricity purchased by the Transmission Licensee; Ceylon Electricity Board (CEB) from Non-Conventional Renewable Energy (NCRE) sources for SPPAs signed on or after 1st January 2012. The tariffs and the SPPA will continue to be standardized. The tariffs will be cost-based and technology-specific, and the developers have the option of selecting either a three-tier tariff or a flat tariff. The SPPAs will continue to be applicable to projects with a rated generating capacity up to 10 MW, and will be valid for a period of 20 years and extendable by mutual consent.

These tariffs will apply to new SPPAs signed between 1st January 2012 and 31st December 2013. Tariffs for electricity produced using Non-Conventional Renewable Energy (NCRE) sources based on Standardized Power Purchase Agreements (SPPAs) would be as follows:

All prices are in Sri Lankan Rupees per Kilowatt-hour (LKR/kWh).

Technology	Escalable Base O&M rate (year 1-20)	Escalable Base Fuel rate (year 1-20)	Fixed Rate			Royalty to Govt, paid direct by the utility (% of total Tariff) Year 16-20
			Year 1-8	Year 9-15	Year 16-20	
Mini-hydro	1.93	None	16.81	6.38	5.80	10%
Mini-hydro-local	1.98	None	17.27	6.55	5.95	10%
Wind	1.30	None	22.63	8.58	7.80	10%
Wind-local	1.34	None	23.29	8.83	8.03	10%
Biomass (Dendro)	1.50(1-15 years), 1.88 (16-20 years)	12.25	9.80	3.72	3.38	None
Biomass (Agricultural& Industrial Waste)	1.50(1-15 years), 1.88(16-20 years)	6.13	9.80	3.72	3.38	None
Municipal Solid Waste	5.31	1.75	19.80	7.51	6.83	None
Waste Heat	0.52	None	10.19	3.86	3.51	None
Escalation rate for year 2012	6.14%	3.37%	None	None	None	None

Note 1: Escalation of O & M rate and fuel rate shall commence from 1st day of the month of January immediately after the commercial operation date.

Note 2: The applicable escalation rate for each subsequent year shall be the rate announced for that particular year.

Note 3: To compensate for the higher tariffs in tier 1, developers will be required to deliver in tier2, an average amount of energy at least equal to that delivered in tier 1. This obligation will be stipulated in the agreement, with corresponding penalties for non-delivery in tier 2.

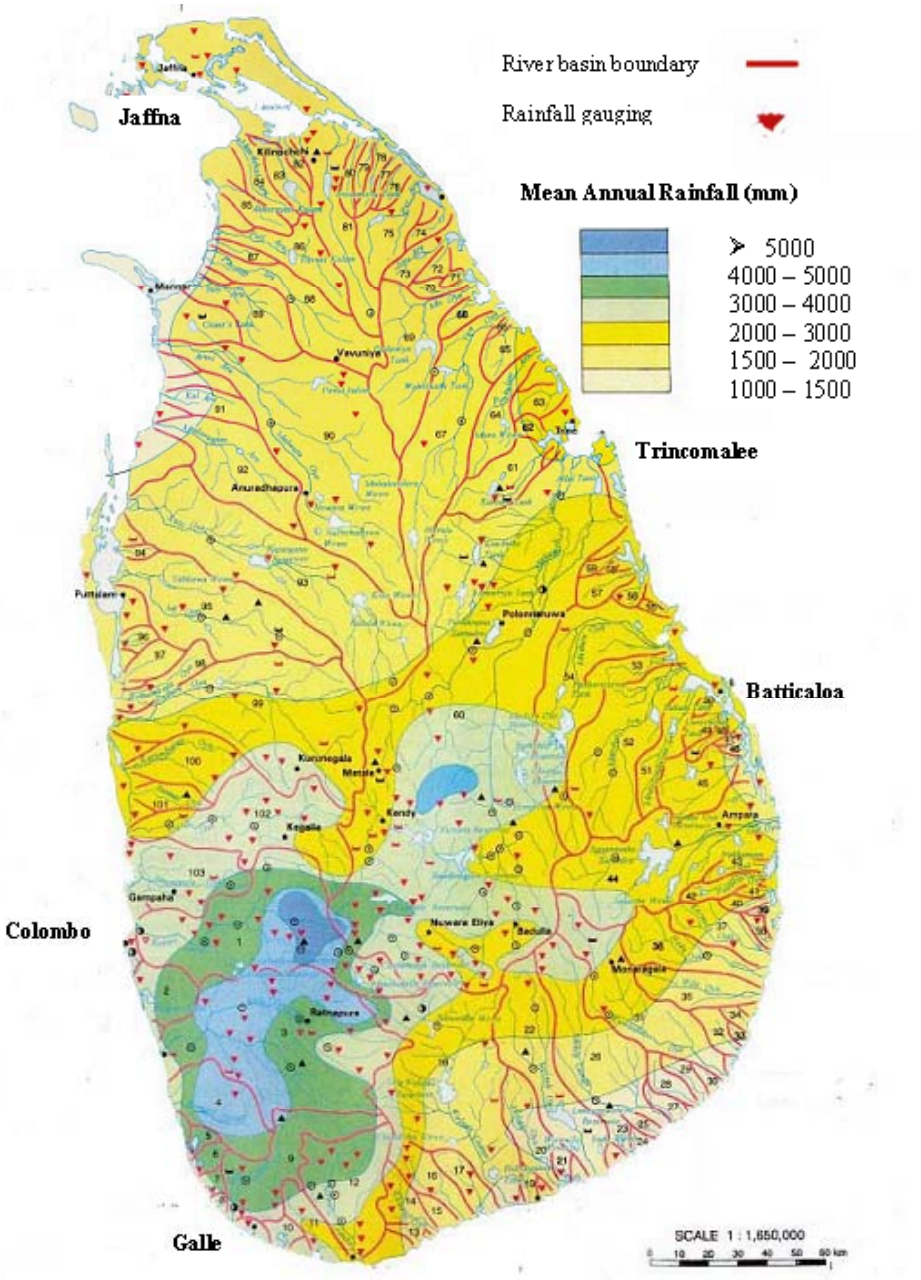
Note 4: Biomass (Dendro) means sustainably grown fuel wood.

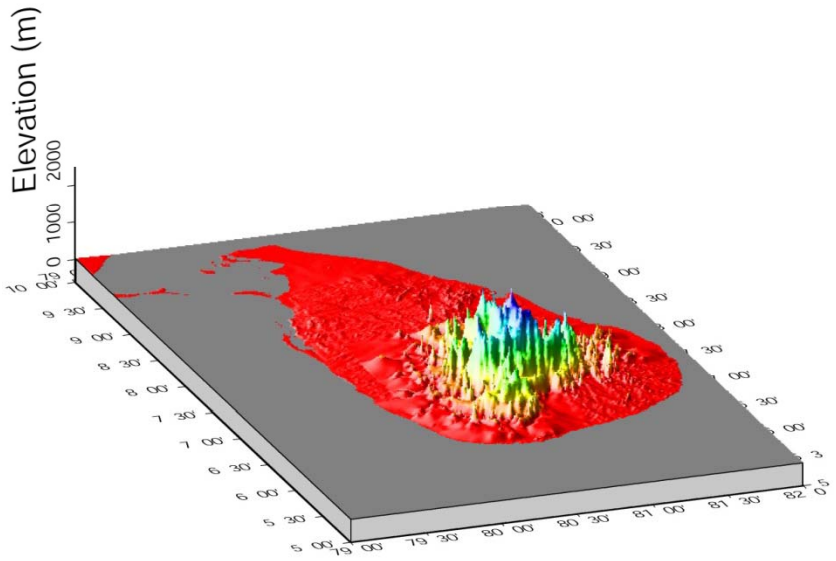
Note 5: 'Mini-hydro – Local' and 'Wind – Local' are plants that use locally manufactured turbine equipment

Option 2: Flat Tariff

Hydropower Development in Sri Lanka
for sustainable development

Water Resources in Sri Lanka

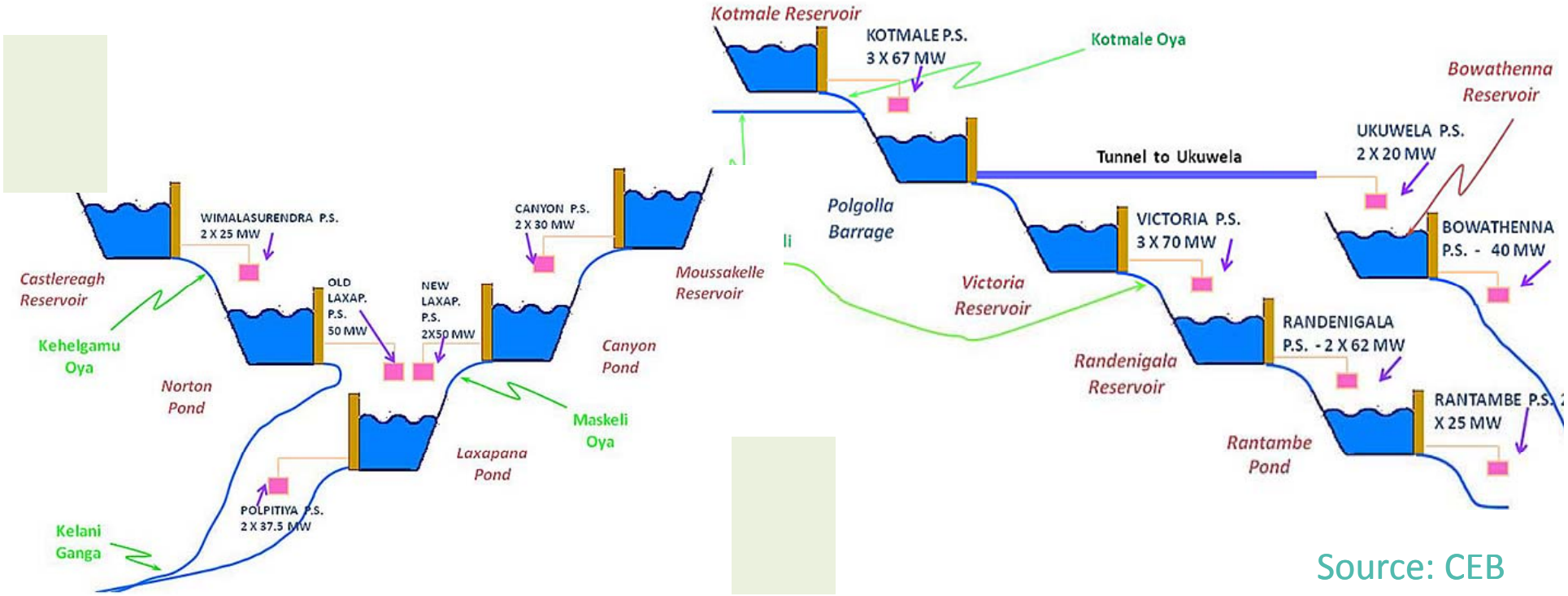




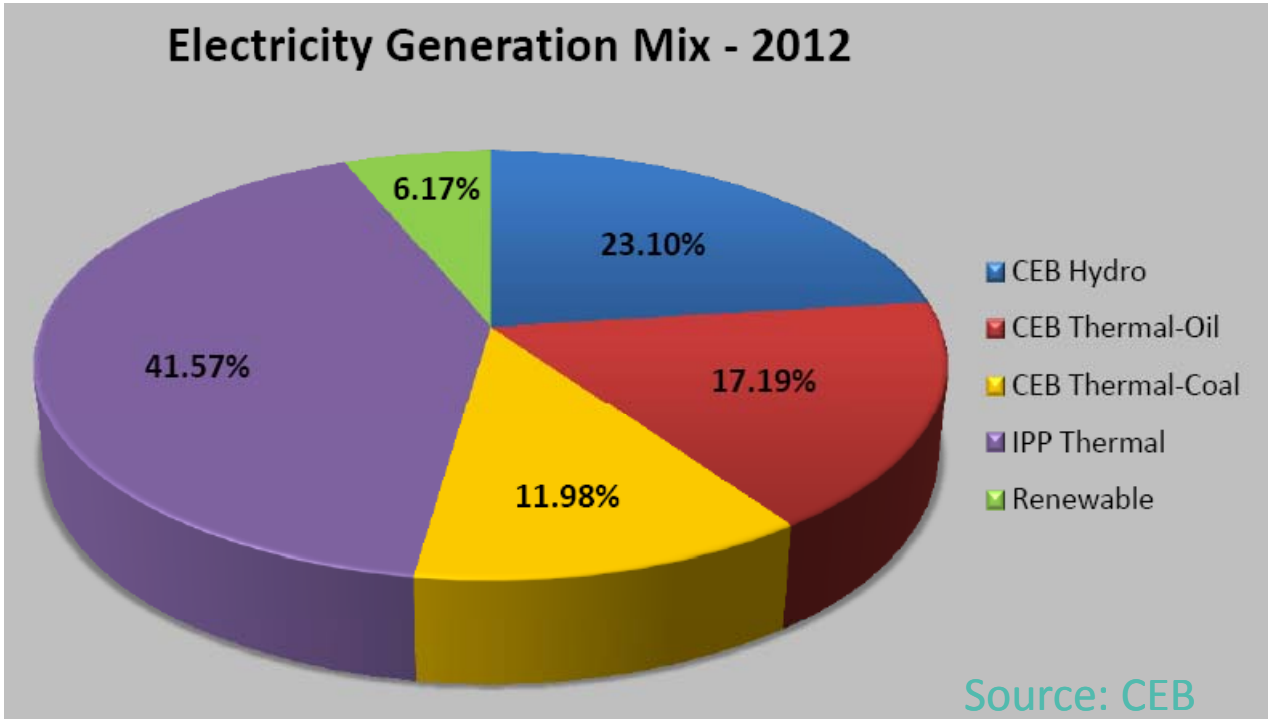
Major hydropower plants

2012

Gross Generation by Source in GWh.		Installed Capa. by Source in MW.	
Hydro	3291		1584
Thermal-Oil & Coal	8338		1638
NCRE	171		90
Total Generation	11801		3312

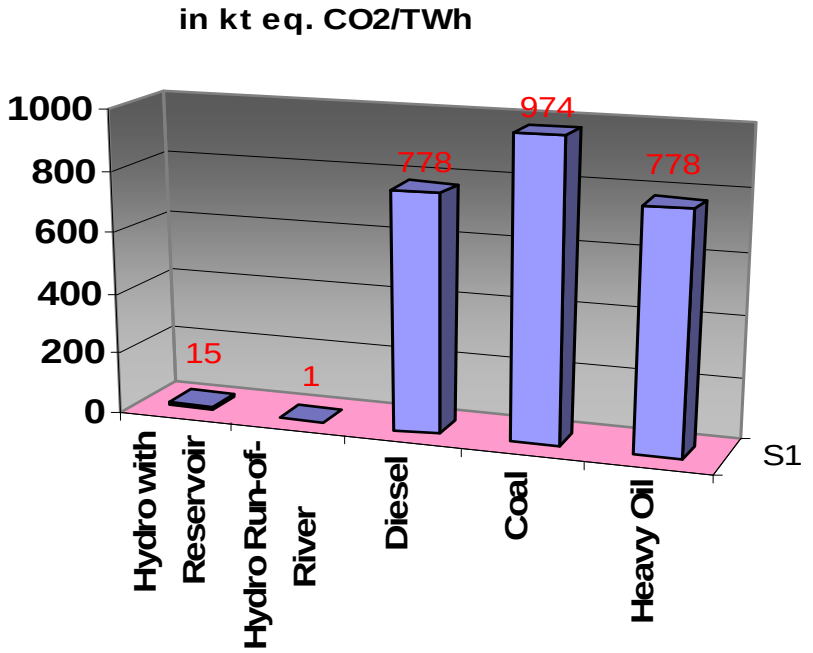


Source: CEB



Source: CEB

Renewable energy to 10% by 2016



Mini hydropower development

- Policy directions in August 1997, private sector is encouraged to develop, own and operate small/mini hydropower plants to generate domestic energy

- Electricity Board purchases hydro energy from mini/small plants under Standardized Power Purchase Agreements.
  e.g. at a fixed price for 15 years

- Small hydropower plants which are generally run-of-river type can provide many benefits to dispersed rural communities

- .However slow implementation:

High capital cost for efficient machinery (cheaper machinery, unreliable inefficient use of the resources!)

Inability to accept the distributed grid connections by the CEB,

no acceptance/high cost for developer!

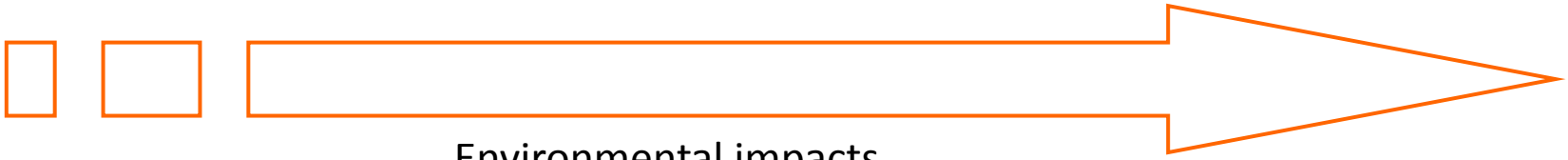
Environmental impacts of hydropower projects

Positive impacts and negative **impacts on**

social,

physical and

ecological environments

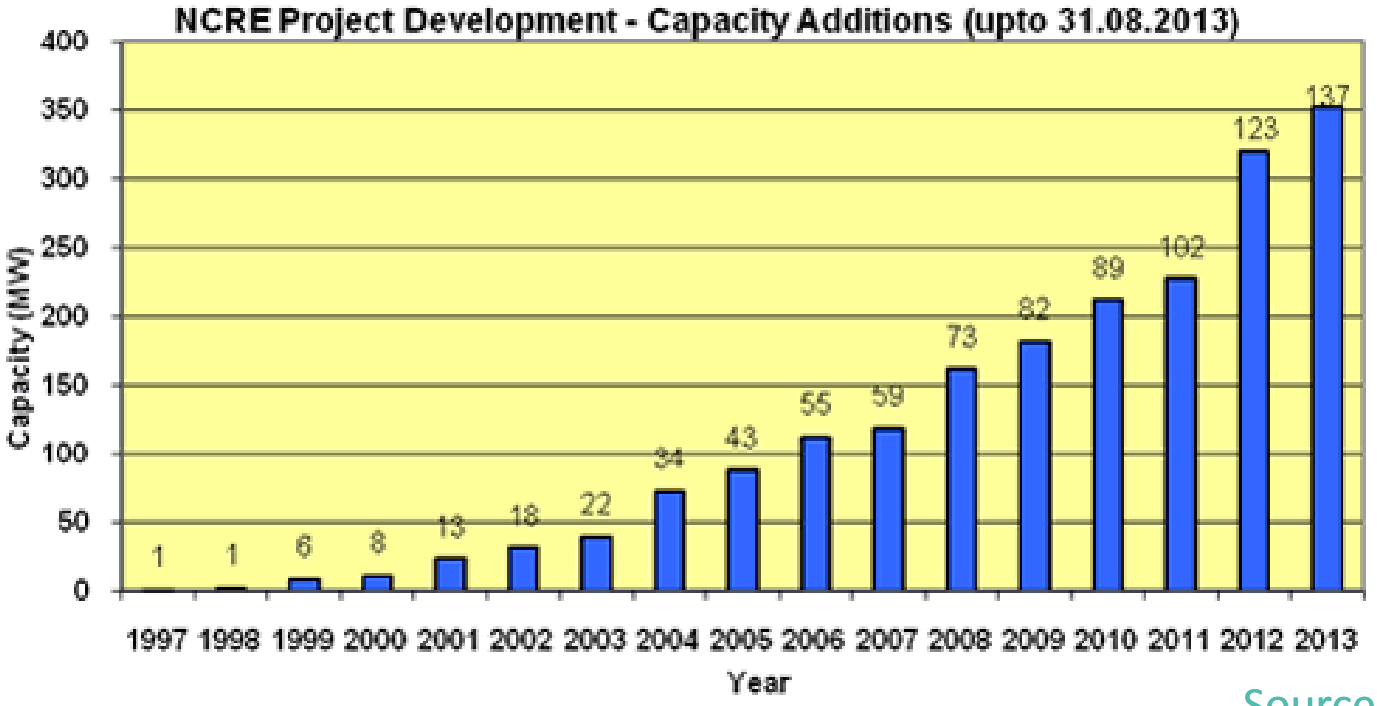


PICO- MICRO- MINI- SMALL- MEDIUM- MAJOR-

HYDROPOWER PLANTS

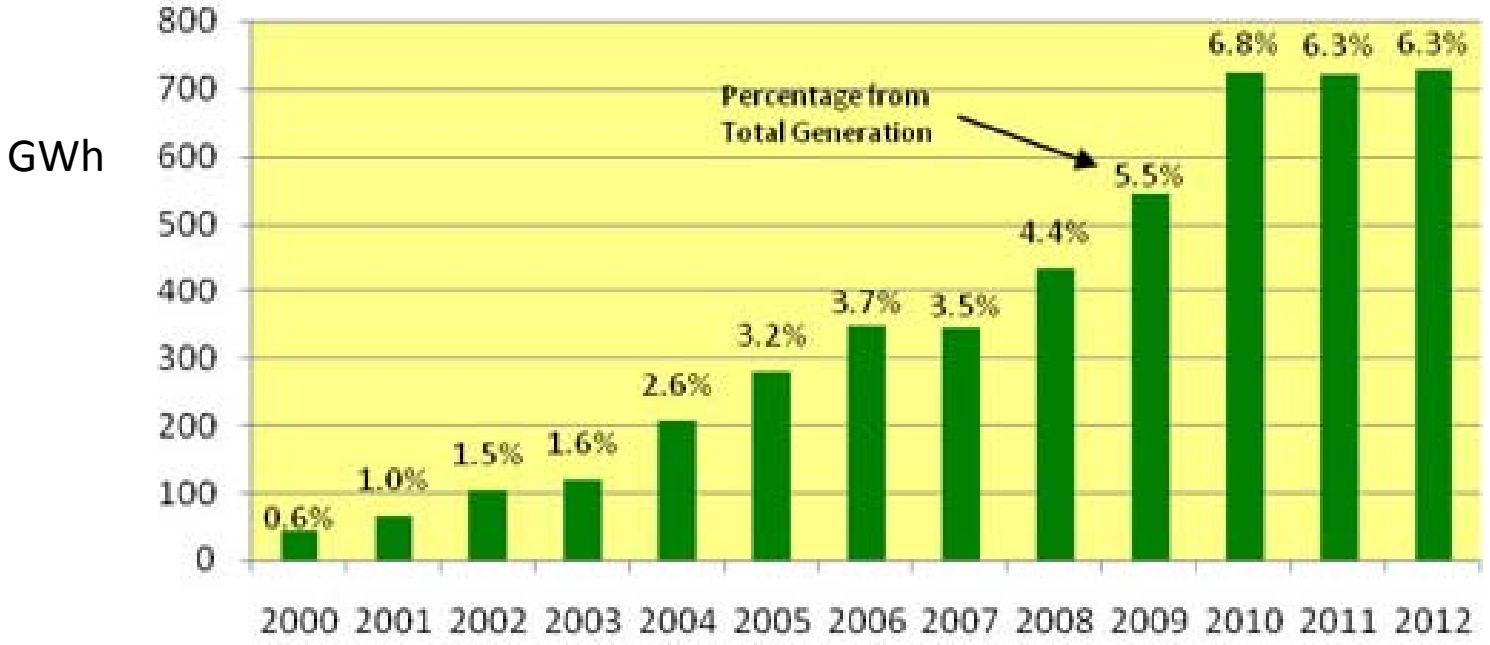
No	Description	Project Type	No. of Projects	Capacity (MW)
01	Commissioned Projects	Mini Hydro Power	119	255.370
		Biomass-Agricultural & Industrial Waste Power	2	11.000
		Biomass- Dendro Power	2	5.500
		Solar Power	4	1.378
		Wind Power	10	78.450
		Total - Commissioned	137	351.698
02	Standardized Power Purchase Agreements (SPPA) Signed Projects	Mini Hydro Power	64	149.802
		ind Power	3	21.100
		Biomass-Agricultural & Industrial Waste Power	2	4.000
		Biomass-Dendro Power	10	56.770
		Biomass-Municipal Solid Waste	1	10.000
		Total – SPPA Signed	80	**241.672**

Source: CEB


NCRE Project Development - Capacity Additions (upto 31.08.2013)
Capacity (MW)
400
350
300
250
200
150
100
50
0
1
1
6
8
13
18
22
34
43
55
59
73
82
89
102
123
137
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Year

Source: CEB

Generation addition

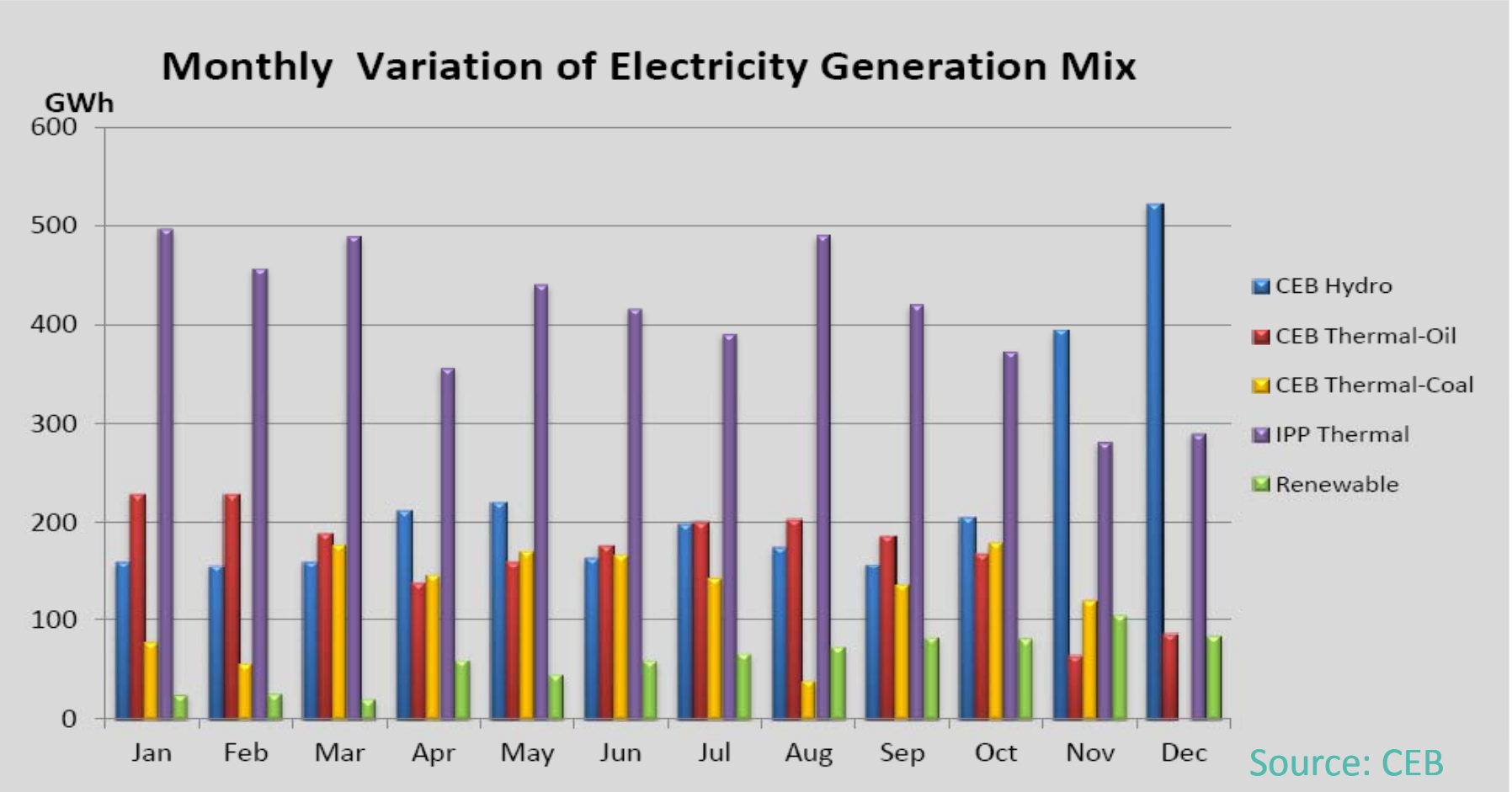


ear	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Cap. (MW)	8.6	11.1	23.6	31.2	39	73	88	112	119	161	181	212	227	320	351

ear	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Energy (Gwh)	43.3	64.8	103	120	206	280	346	344	433	546	724	722	730

Source: CEB

The chart below shows the monthly variation of generation mix in Sri Lanka during the year 2012.



Run-of-river MHP/SHP provides lowest contribution during dry period and the country energy generation plan has to adjust accordingly

Disaster Risk Reduction for Sustainable Development

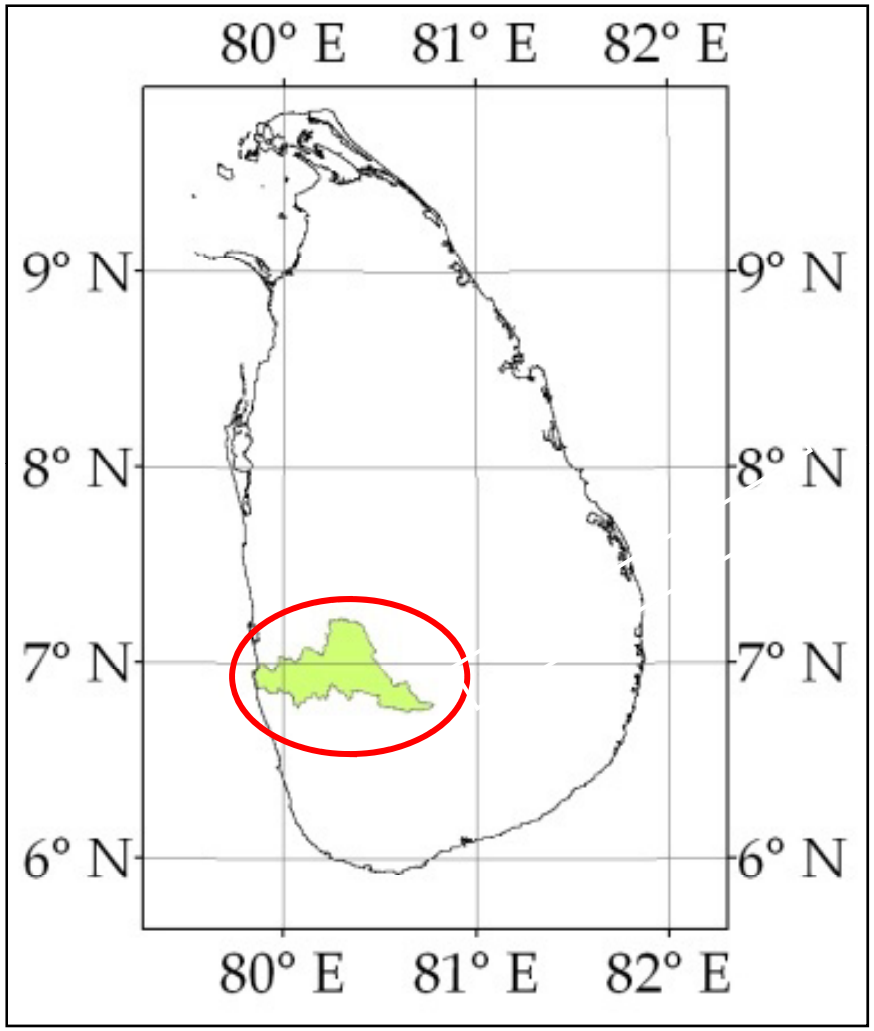
A Case study-
Flood Inundation along the Lower Reach of Kelani River Basin under Changing Climate, and Adaptation Strategies

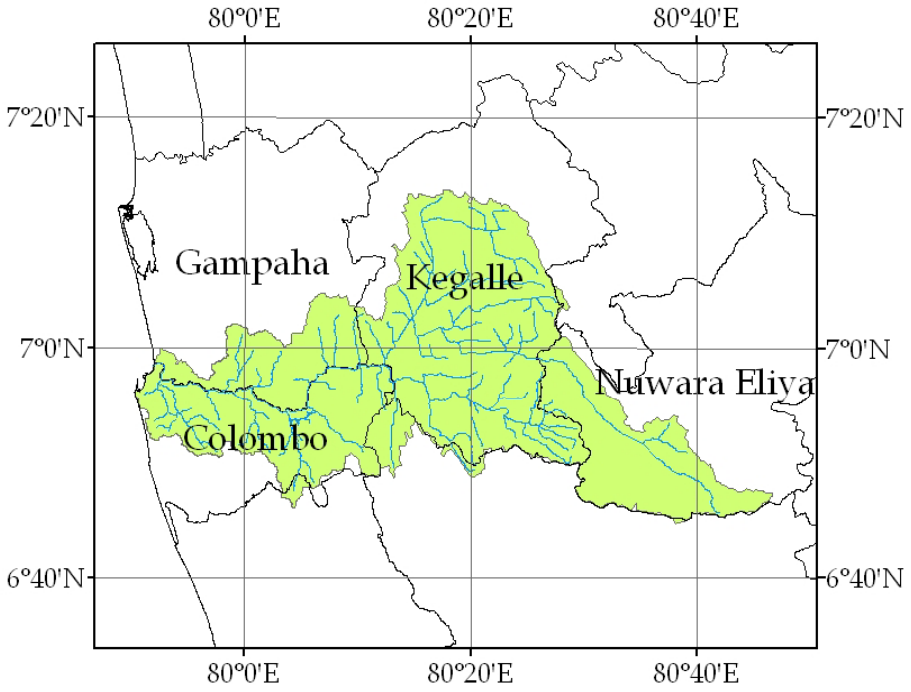
S.B Weerakoon[1], Srikantha Herath[2] , Gouri De Silva[1]

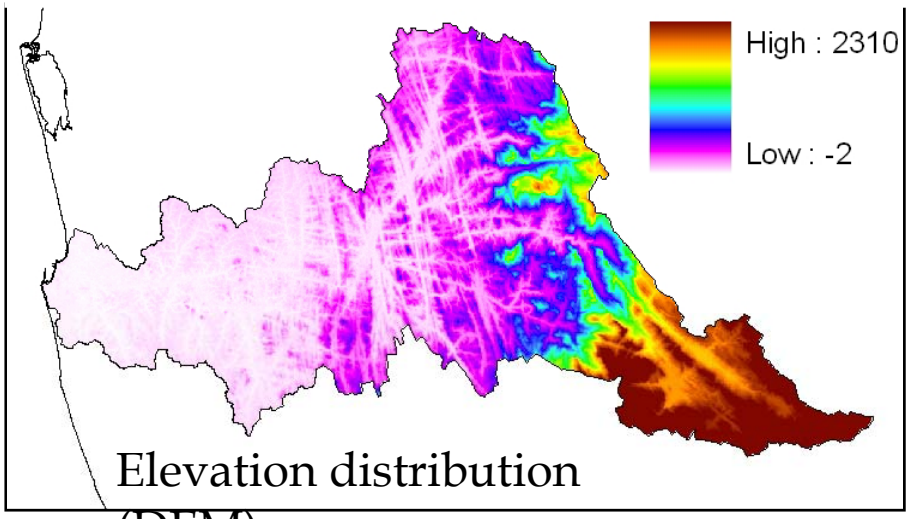
[1]*Department of Civil Engineering, University of Peradeniya, Peradeniya, Sri Lanka*

[2]*United Nations University, Shibuya-ku, Tokyo, Japan*

Kelani River Basin





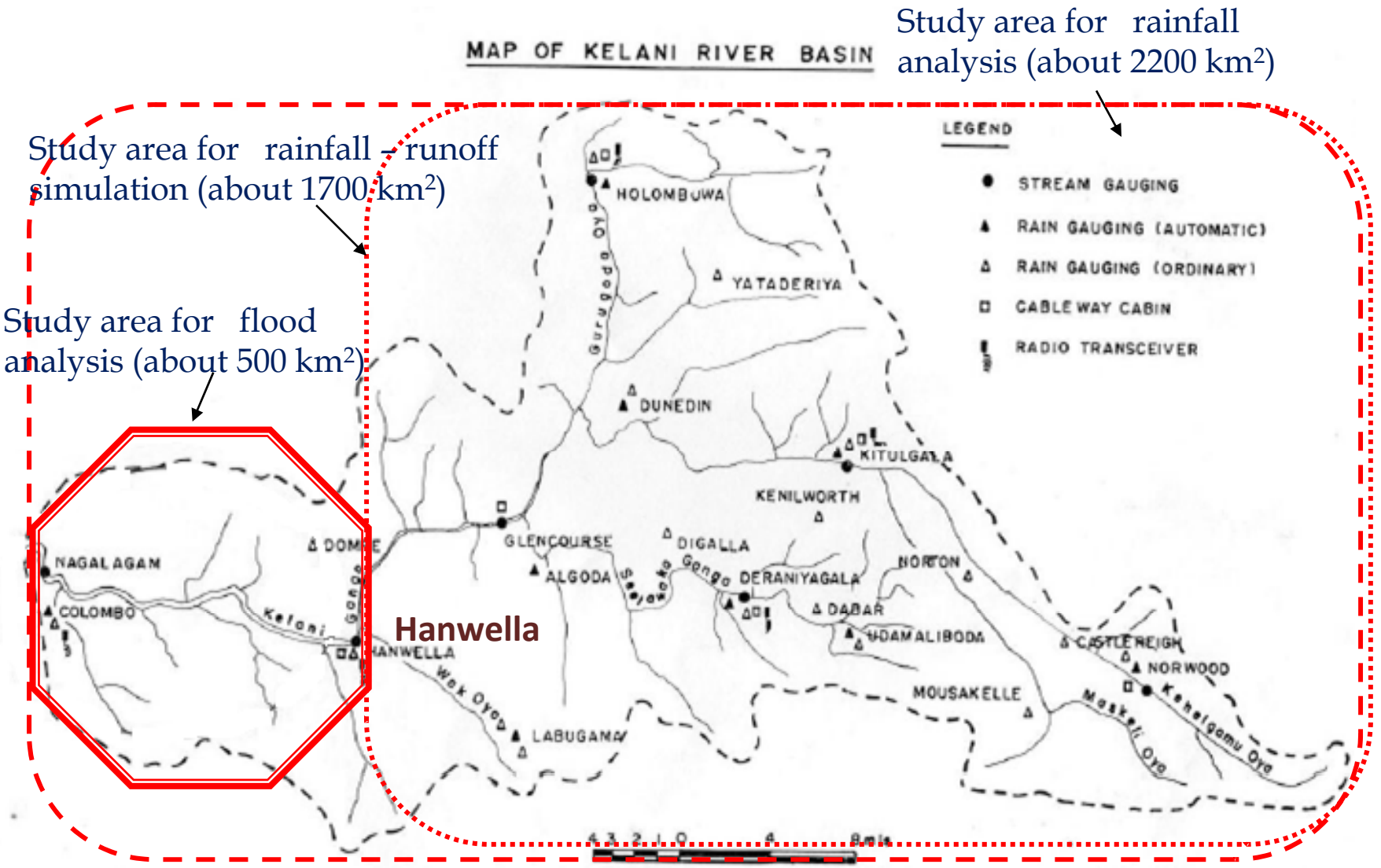


Flood inundation in Colombo and suburbs create heavy economic damages

Kelani River Basin

- Region – Wet Zone
- Total Basin Area – 2,230 km^2
- Uppermost Elevation – 2,250 m
- Length of the River – 192 km
- Average Annual Rainfall – 2,400 mm
- Peak flow – 800-1500 m^3/s
- Vegetation cover
  - Upper basin – Tea, rubber, grass and forest
  - Lower basin – heavily urbanized

Kelani River Basin

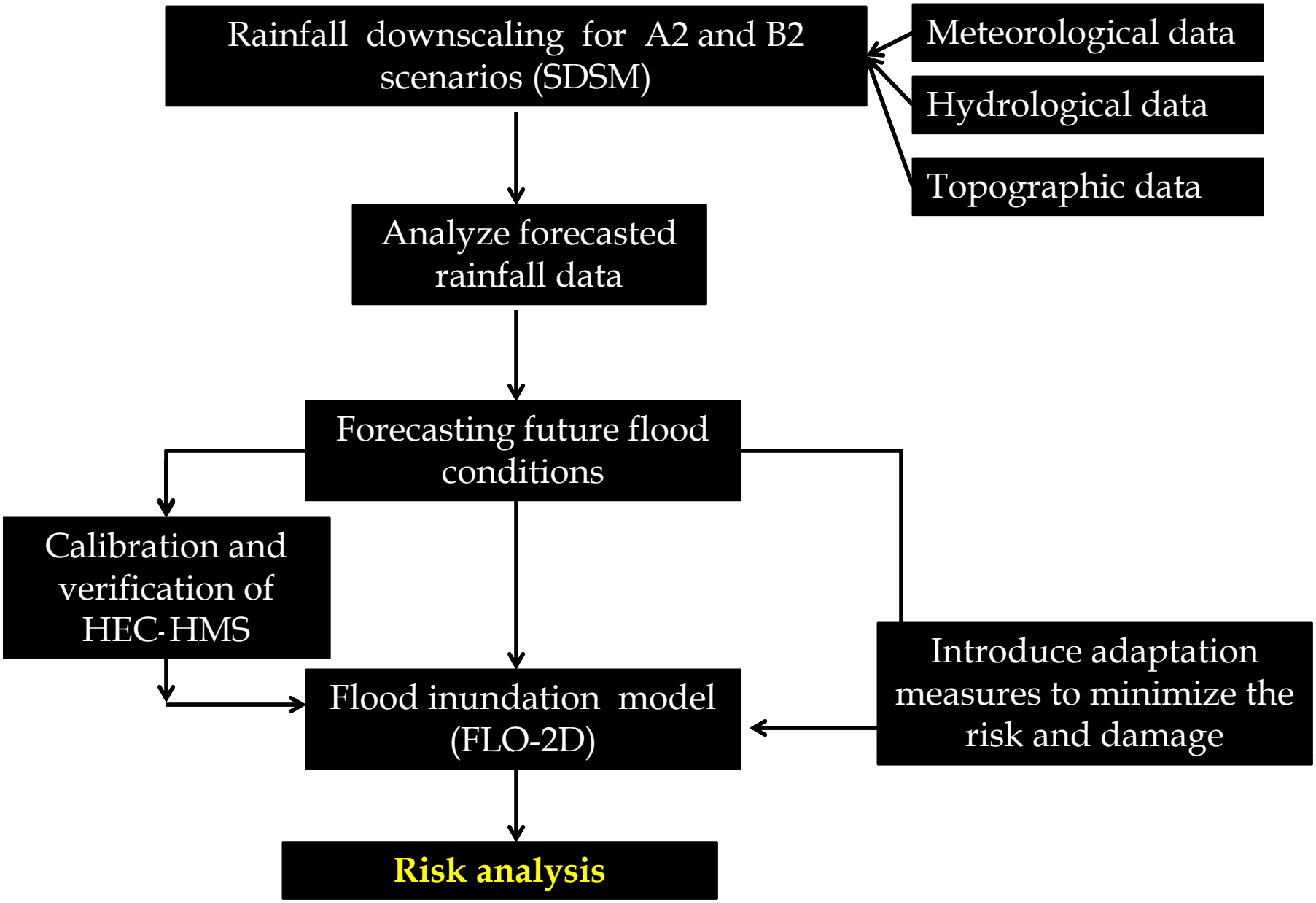


Source: Department of Irrigation, Sri Lanka

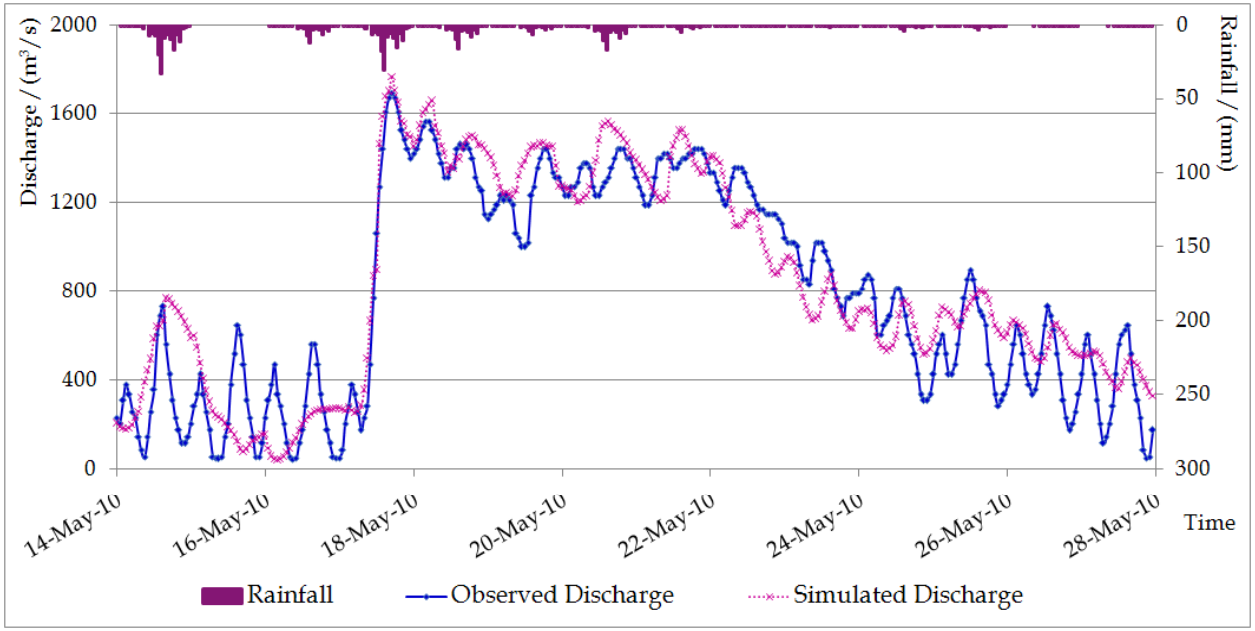
Objective

To estimate flood inundation and accompanied risk factors, in the lower Kelani River basin due to climate change impacts under A2 and B2 scenarios of AR4 and to propose adaptations

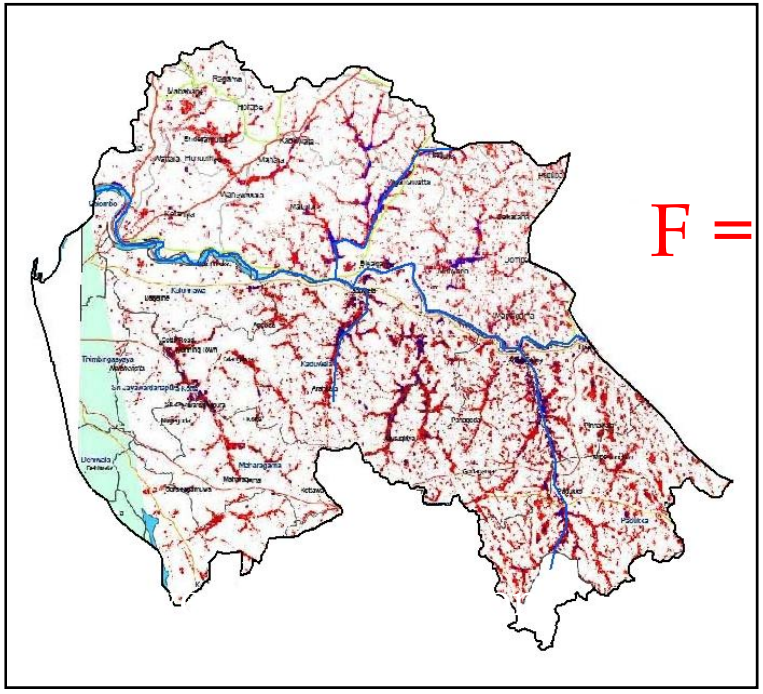
Methodology



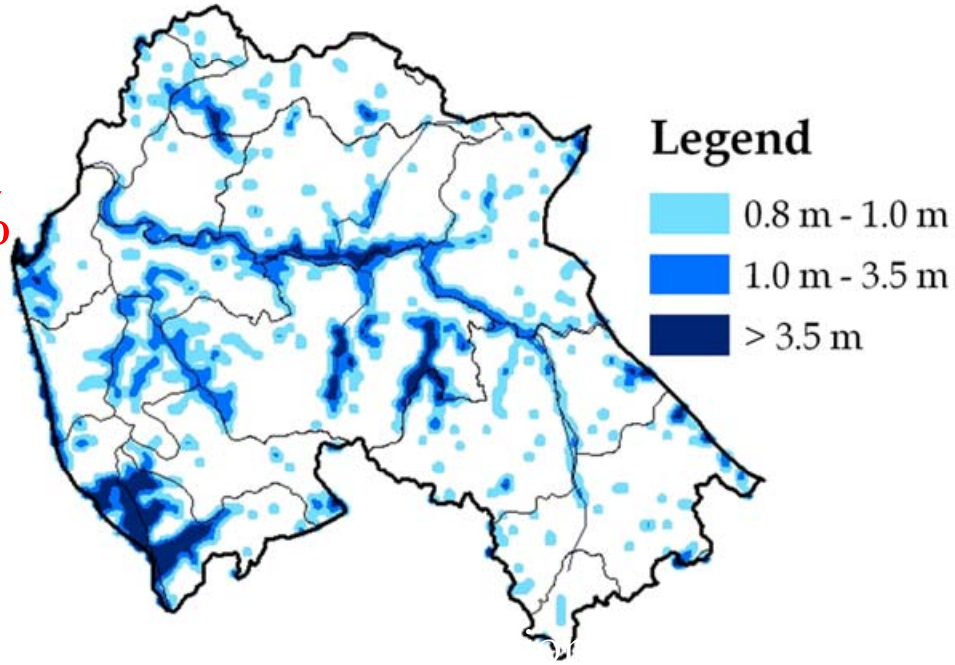
Validation



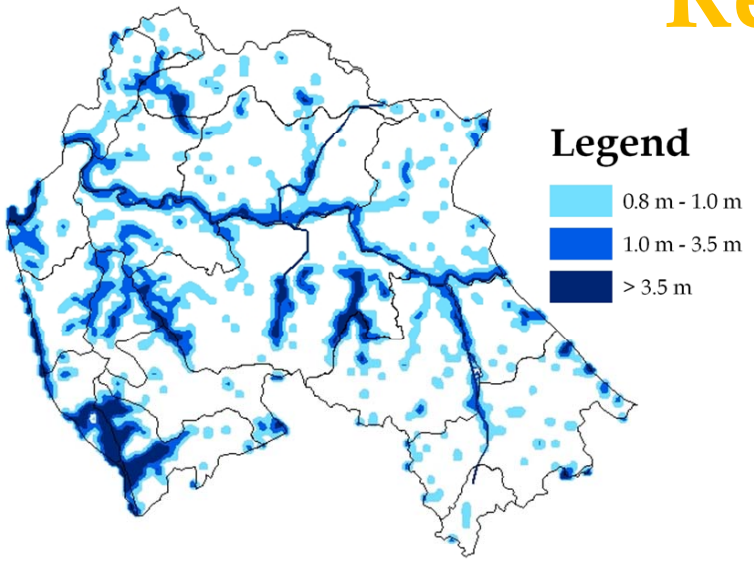
Time series of observed and simulated flow at Nagalagam Street gauging station during May 2010 flood



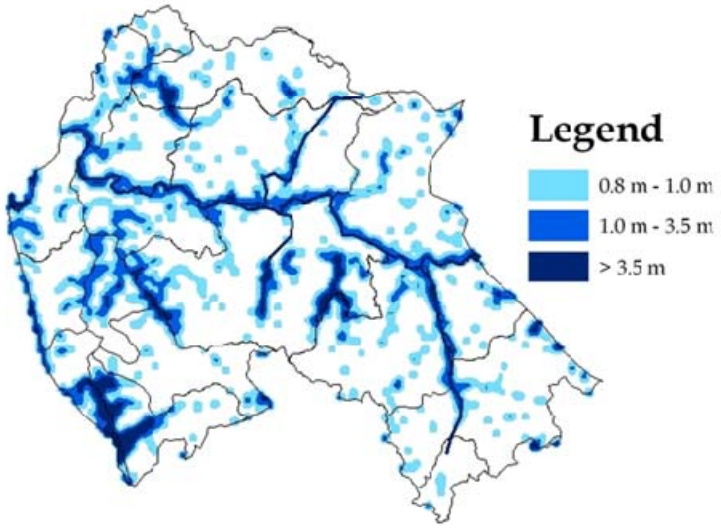
F = 73%



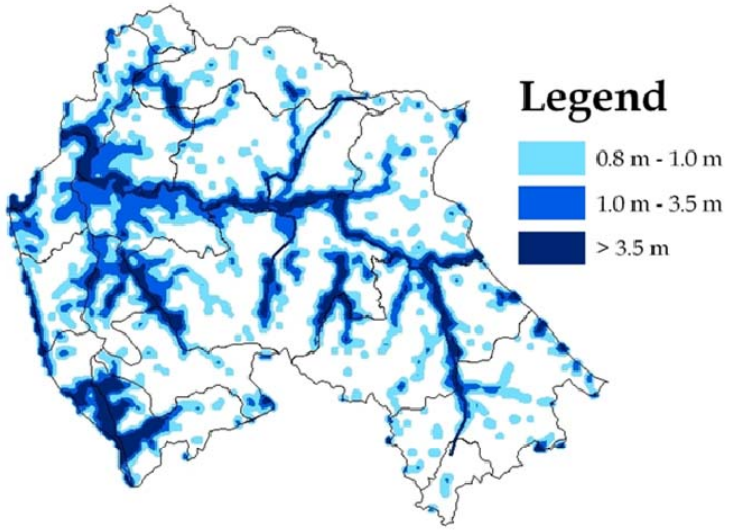
Results



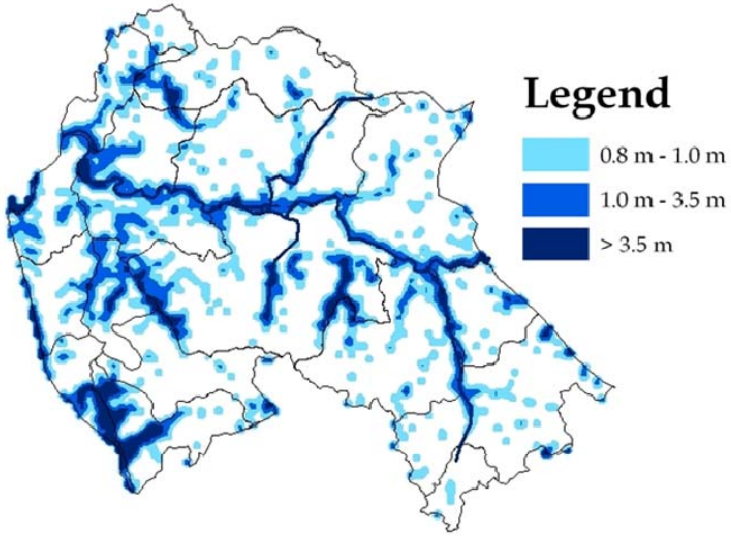
Inundation extents due to 50 year return period rainfall under A2 scenario



Inundation extent correspond to 50 year return period rainfall under B2 scenario



Inundation extents due to 100 year return period rainfall under A2 scenario

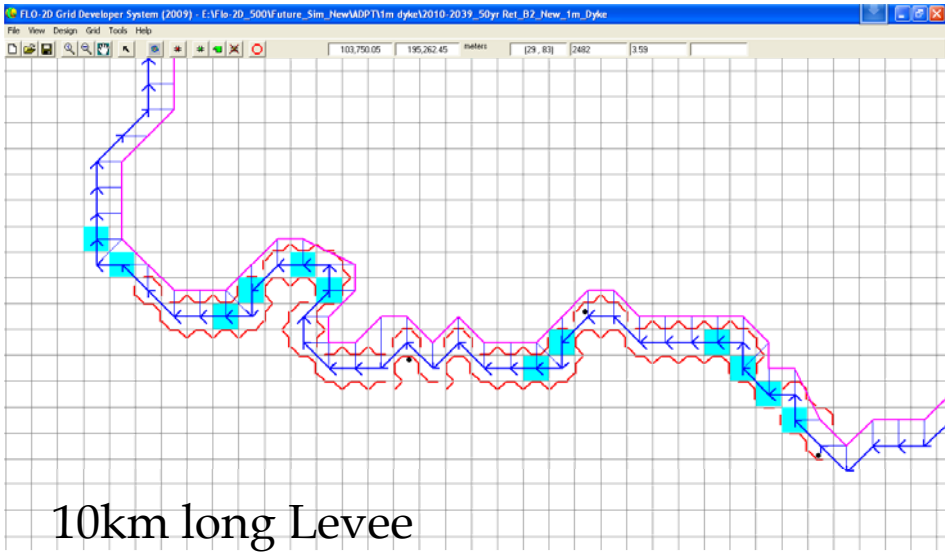


Inundation extent correspond to 100 year return period rainfall under B2 scenario

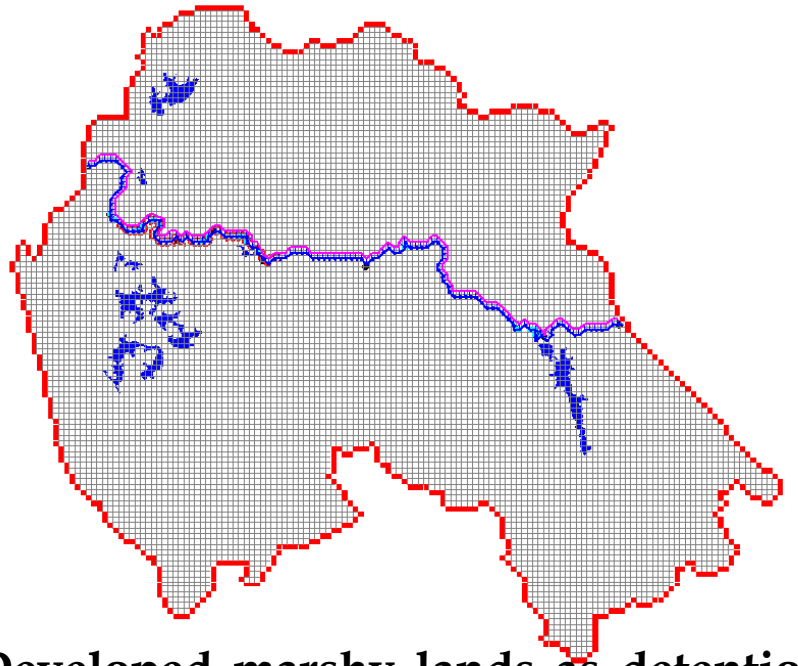
Adaptation strategies

Levee and detention basin

- A levee of 1.0 m height and 10 km long from the downstream
- Detention reservoirs; several marshy lands were identified from land use maps and converted in to detention reservoirs.

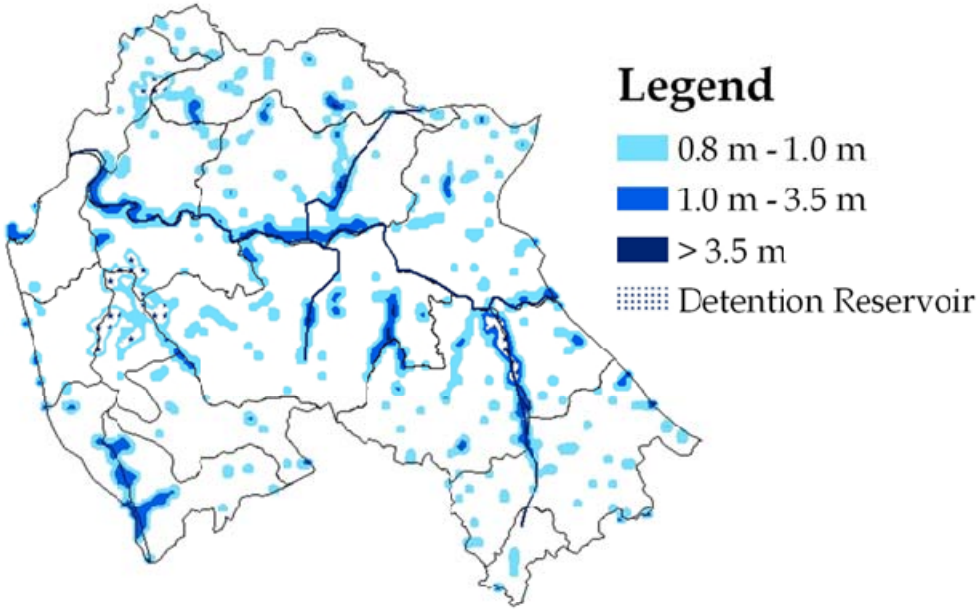


10km long Levee



Developed marshy lands as detention reservoirs

Results – Inundation extents under (c)

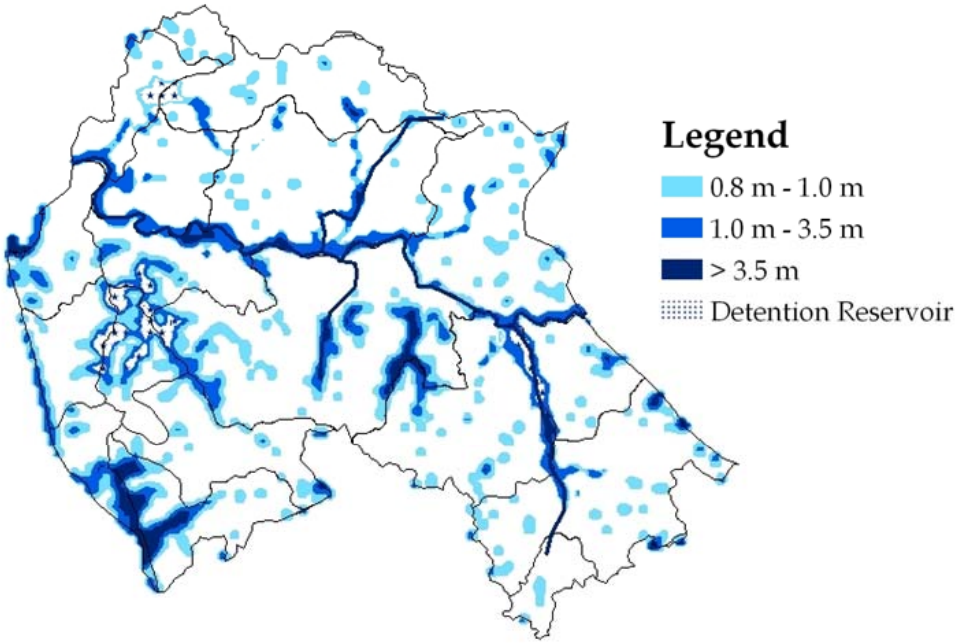


50 year return period rainfall under A2 scenario

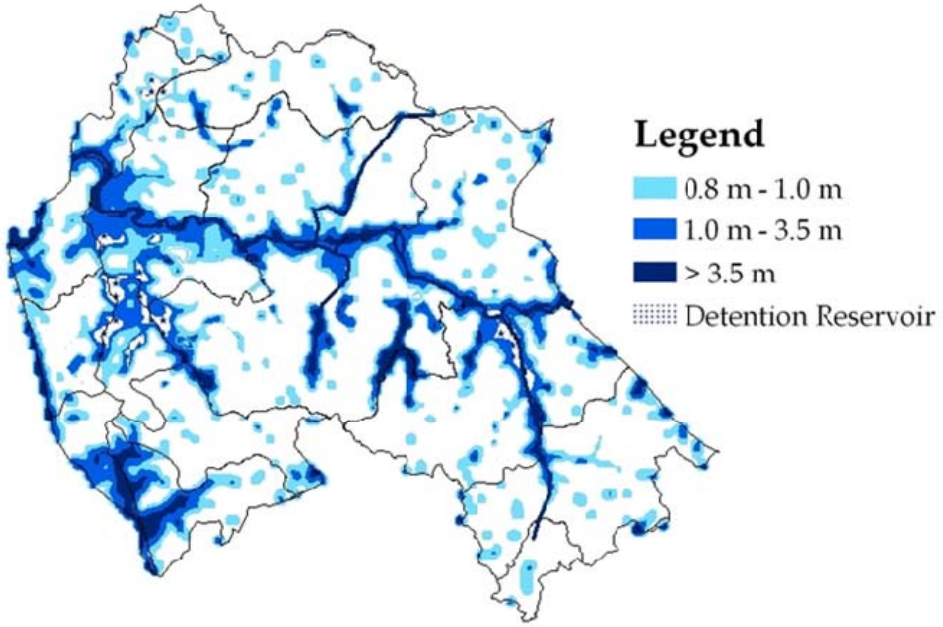
Reduces average risk about 65%

50 year return period rainfall under B2 scenario

Reduces the average risk about 40%



Results – Inundation extents under (c)

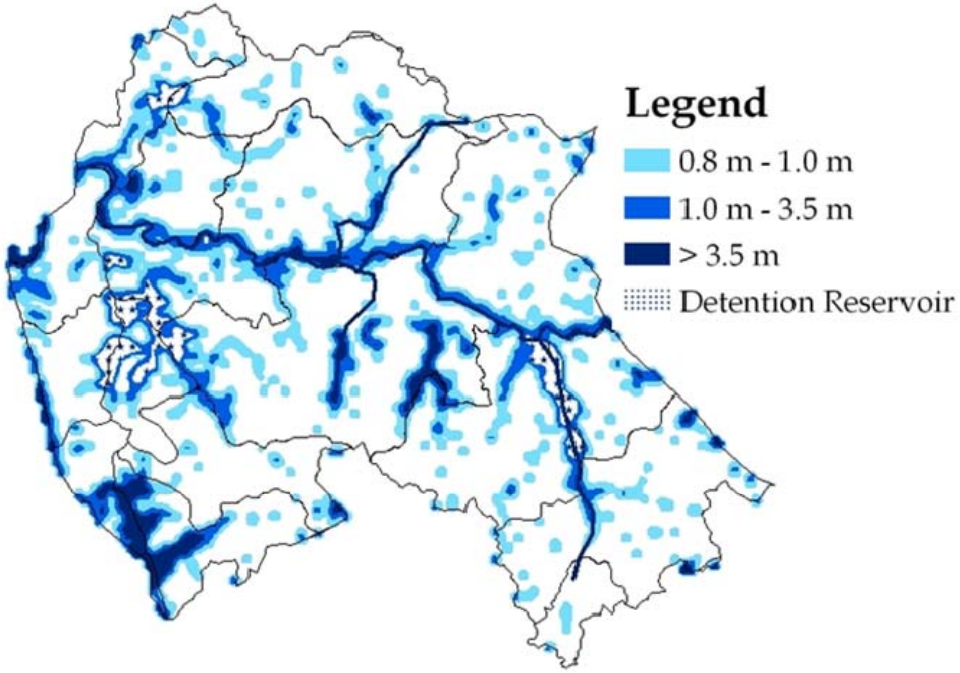


100 year return period rainfall under B2 scenario

Reduces the average risk about 25%

100 year return period rainfall under A2 scenario

Reduces the average risk about 32%



Concluding Remarks

- Government has taken number of initiatives for low carbon, sustainable developments.

- Hydropower in SL has a significant contribution for her sustainable development.
- Small hydropower plants which are generally run-of-river type can provide many benefits to dispersed rural communities. NCRE projects are encouraged to achieve 10% share of electricity generation by 2016. Incentive needed!

- Adaptation for disaster risk reduction under CC impacts for sustainable development is important

Case study - Inundation extents and high risk areas of inundation by rainfalls of 50, 100 year return periods under both A2 and B2 scenarios in Colombo were investigated

Way forward - 3E nexus for sustainable development


Devon waterfall
(Upper Kotmale Subbasin)
Thank You

Ownership & Source of Power Station	No.of Power Stations			Installed Capacity in MW.		
	2010	2011	% Change	2010	2011	% Change
C.E.B. - Total	**23**	**24**	**4.3%**	**1758**	**2058**	**17.1%**
- Hydro	16	16	0.0%	1207	1207	0.0%
- Thermal-Oil	6	6	0.0%	548	548	0.0%
- Thermal-Coal	-	1	-	-	300	-
- Wind	1	1	0.0%	3	3	0.0%
P.P.P. - Total	**105**	**115**	**9.5%**	**1059**	**1082**	**2.2%**
- Hydro-Small	85	90	5.9%	175	194	10.4%
- Thermal-Oil	11	11	0.0%	842	842	0.0%
- NCRE	9	14	55.6%	42	47	11.4%
Total	**128**	**139**	**8.6%**	**2818**	**3141**	**11.5%**

	Gross Generation in GWh			Percentage of Total	
Ownership & Source	**2010**	**2011**	**% increase**	**2010**	**2011**
C.E.B. - Total	**6386**	**6552**	**2.6%**	**60%**	**57%**
- Hydro	4988	4018	-19.5%	47%	35%
- Thermal-Oil	1394	1494	7.1%	13%	13%
- Thermal-Coal	-	1038	-	-	9%
- Wind	3	3	-11.1%	0%	0%
P.P.P. - Total	**4329**	**4976**	**14.9%**	**40%**	**43%**
- Hydro-Small	646	604	-6.5%	6%	5%
- Thermal-Oil	3600	4254	18.1%	34%	37%
- NCRE	83	118	43.0%	0.8%	1.0%
Total Generation	**10714**	**11528**	**7.6%**	**100%**	**100%**