Control of Indusrial water Pollution and Status of water quality in Dadugam Oya

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Threats to the water environment

Population growth

Industrial Development

Water Environment

Climate change

If current development trend continues, the pressure to the water environment will grow more and more.

Major Activities deteriorate the Water Quality

- Untreated wastewater discharge
  - » Domestic
  - » Industrial
  - » Sewage (Raw /Partially treated)
- Dumping of solid waste.
- Agricultural run off
  - » Agro chemicals
  - » Fertilizers
- Sand mining activities
- Unplanned development activities
- Boat operating for recreation
- Excessive water usage

Major Industrial Sector contribute to water Pollution

- Chemical Industries
- Food and Beverages
- Alcohol and alcoholic beverages
- Metal finishing Industries
- Dairy Industries
- Textile Industries
- Leather Tanning Industries
- Rubber Processing Industries
- Desiccated coconut Industries
- Agrochemical Industries
- Pharmaceutical Industries
- Clay & Glass Industries

Dumping of Solid waste into Surface water Bodies

Institutes for Water Environment Management in Sri Lan

Maintenance of Mahaweli river and its reservoir (MA)

Industrial and domestic water Supply (NWSDB)

Regulation & control of inland waters (DOI)

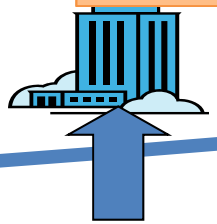
Overall responsibility for protecting water Environment (CEA

Sewage management (NWSDB)

Research on Fishery Aquaculture (NARA)

Conservation of coastal zone (CCD)

prevention of marine pollution (MPPA)



Management of ground water resources (WRD)

CEA
Central Environmental Authority

CCD
Costal Conservation Department

MPPA
Marine Pollution Prevention Authority

NWSDB
National Water Supply & Drainage Board

NARA
National Aquatic research Agency

DOI
Department of Irrigation

MA
Mahaveli Authority

Environmental Protection in Sri Lanka

- In Sri Lanka there are a multitude of laws (more than 100) with some provisions relating to environmental protection and Management on water.

- Some of the earliest legislation dates back to the last century (eg. Forestry, Protection of high elevations)

Environmental Protection In Sri Lanka

- The National Environmental Act no 47 of 1980, is the first comprehensive piece of legislation dealing exclusively with environmental Protection and Management.

- The Central Environmental Authority (CEA) was set up in 1981 to implement the provisions in the National Environmental Act.

- At the inception, the CEA was a COORDINATING AND POLICY MAKING body with no regulatory authority.
- In 1988, amendments were made to the NEA which transformed the CEA into a regulatory Agency.

Central Environmental Authority

- The Central Environmental Authority is the National Agency for Environmental Protection and Management in Sri Lanka.

- CEA acts as a regulatory agency in approving new infrastructure and industrial projects.

- It also maintains quality of the environment through the stipulation of emission standards as well as ambient standards

Regulatory tools & standards

Part IV- Environmental Management and Protection

- Part IV A- Environment Protection

  Environment Protection Licence (EPL) Procedure

  Hazardous Waste Management Licence (HWML) procedure

  Part IV B- Environment Quality

  Environmental Standards for Emissions

  (Wastewater, Noise, Air emission, Vibration)

  Part IV C- Environment Management

  Environmental Impact Assessment (EIA),Strategic Environmental Assessment SEA)

Part IV A Environment Protection

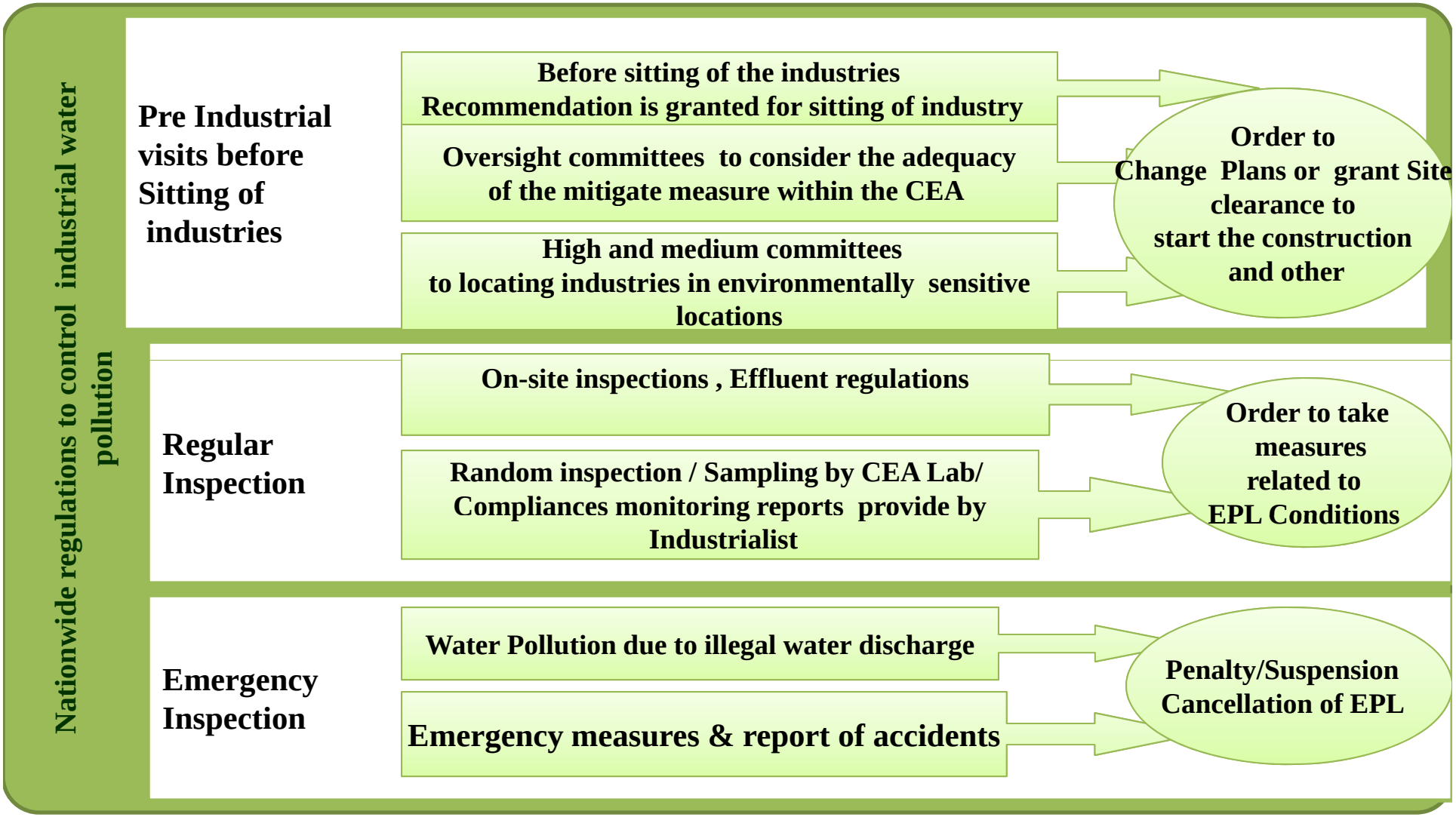
- EPL Regulations - No. 1533/16 of 25.01.2008-

Objectives:

- To prevent or minimize the discharges and emissions into the environment
- To develop an approach to Pollution Control through
  - The best practicable Environmental Option (BPEO)
  - Best Available Techniques Not Entailing Excessive costs BATNEEC
- Prescribed Activities- 138
- List A-80 (high)
- List B-33 (medium)
- List C-25 (low)

Industrial Wastewater Management in Sri Lanka

How Industrial Water Pollution Control By EPL



Water Quality Monitoring
Selected surface water bodies

Measurement Program by CEA

Implementation of regular monitoring Programme to control surface water pollution

Waste Water Discharge Standard

- Standards for Inland Surface waters.
- Standards on land for irrigation Purposes.
- Standards for Industrial and Domestic waste into Marine Coastal Areas.
- Standards for waste from Rubber Factories into Inland Surface waters.
- Standards for waste from Textile Factories into Inland Surface Waters.
- Standards for waste from Tanning Industries into Inland Surface Waters.
- Standards for effluents into public Sewers with Central Treatment Plants.

Water Quality Monitoring

Purpose

- Getting a full understanding of the status of water pollution in public waters and underground water, and implementing control measures for the prevention of water pollution in appropriate ways.

Monitoring System

Regular Monitoring of Water Quality

- Monitoring the pollution of water in the environment plays a very important role in getting the basic data for the planning of water environment administration.
- It should be carried out throughout the country uniformly and with accuracy. The CEA is required to implement this task with responsibility.
- However, the continuous monitoring of water quality could not be performed through out the country due to various constraint
- It is conducted for several selected water bodies on monthly basis.
- **Monitoring of Effluent**
- The monitoring of industrial effluent quality is conducted by CEA in regular basis (At least once A year for all industries which are having EPL or else once in three months for the industries which are located in environmental sensitive areas)

Thank You

Status of Water Quality in Dadugam Oya

Introduction

- Integral part of any environmental monitoring programme is the reporting of results to the manger as well as the general public.
- But the political decision makers , non technical water manager and the general public neither time or knowledge to study and understand traditional technical review of water quality data

……Continuation

- One possible solution to this problems to reduce the multivariate nature of water quality data by employing an index that will incorporate data from multiple water quality parameter into a mathematical equation that raised the health of the stream with a number

Why this water body is important

The water in Dadugam is used for following activities such as Water intake at Kotugoda for Raddolugama scheme, Sand mining ,Agricultural Activities, Other activities Salinity Bridge at Opatha

The main objective of study is

- To evaluate the water quality in several selected locations of the Dadugam Oya with respect to the proposed ambient water quality standard stipulated by the Central Environmental Authority
- Develop a Water Quality index using Canadian council of the environmental (CCME 2011)
- Assign grade and a color code to the calculate value index value
- Communicate these water quality data information to the general public and legislative decision maker

Methodology

- Frequency of sampling
  - Monthly Basis from March 2011- December 2012
- Types of Samples – Integrated Grab samples
  - Samples were collected from on either side and middle of the bridge one feet below the surface water level and mix to get a representative sample.
  - Field parameters (pH , Electrical Conductivity, Turbidity and temperature were measured in situ by using Portable Water quality Checker - Horiba U -10)
  - Samples were preserved and brought to the laboratory for analyzed for DO , BOD_5 , COD, Chloride, Dissolved form Heavy metals , Nitrate and Phosphate and Microbiological parameters (Analysis were done according to the standard method for examination of waters and waste water 20^{th} Edition).

Water Quality Index

- The CCME WQI relies on measure of the scope ,frequency and amplitude of excursions from objectives
- The CCME WQI relates to the way in which the individual factors are combined to provide a final index value
- WQI is unit less number ranging from 0-100.
- A value of 100 is the best possible index score
- A value of 0 is the worst possible.
- Once the CCME WQI value has been determined, water quality is ranked by relating it to one of the following categories.

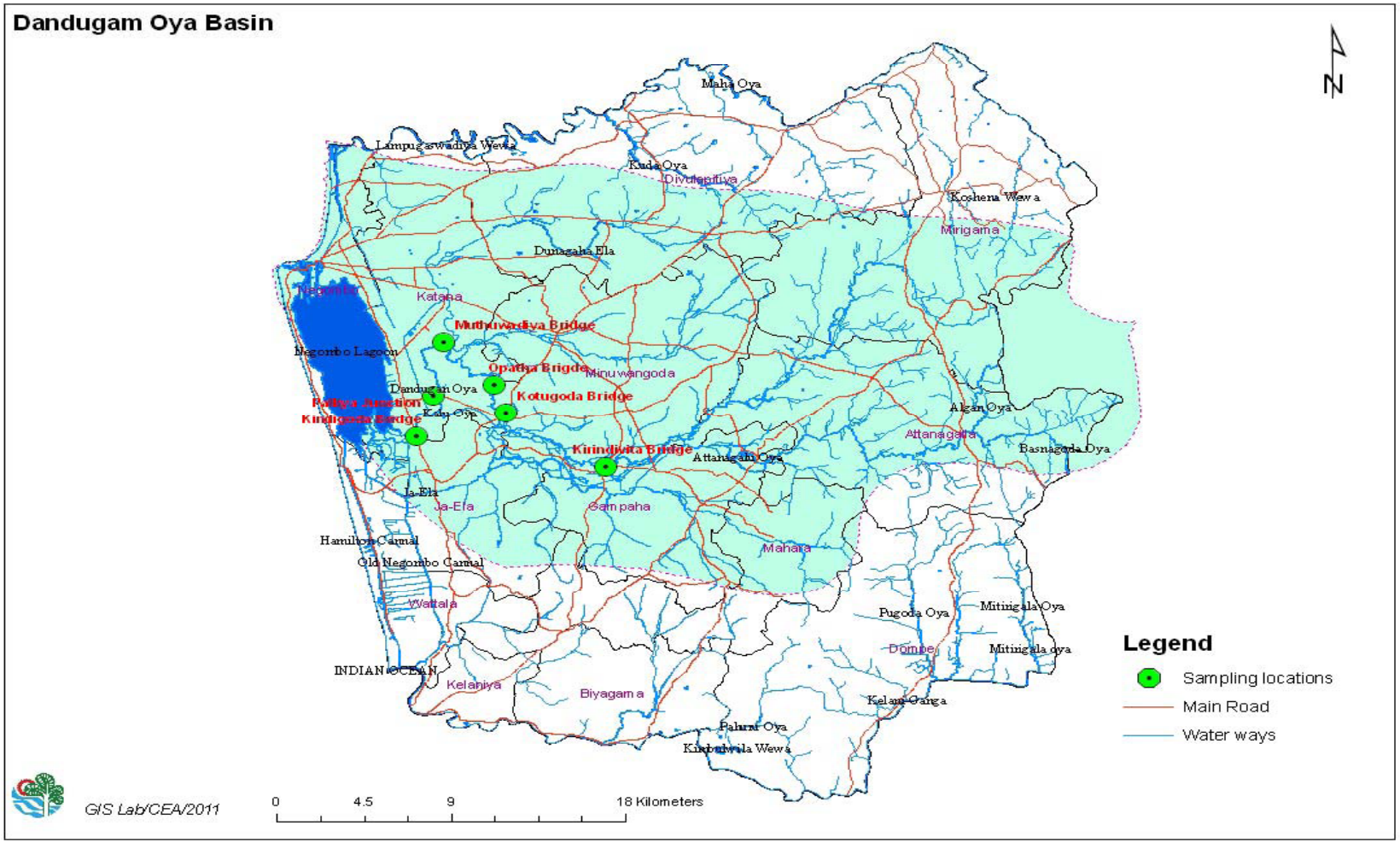
Water Quality Index

Index Value	Ecological Condition	Color Code	Grade
95-100	Excellent		A
80-94	Good		B
65-79	Fair		C
45-64	Poor		D
0-44	Very Poor		E

Methodology

- Sampling points were selected by considering the following factor in order to take representation samples as well as to study the impact of actual natural and anthropogenic activities on water pollution impact
  1. Locations of major drinking water intakes.
  2. Major point and non point sources of waste water discharges.
  3. Sand mining and bathing and other anthropogenic activities .
  4. Rough distance between each sampling Location (10 km).
  5. Ease access to the sampling Location.

Map of the Dadugam Oya



Sampling Locations

Sampling Location	GPS Locations
Kiridivita Bridge	(44386380E, 0784148N)
Kotugoda Bridge	44381229E, 0787535N)
Opatha Bridge	44380612E, 0789277N)
Muthuwadiya Bridge	44377962E, 0791871N)
Palliya Junction Bridge	44377454E, 0788598N)
Kindigoda Bridge	44376592E, 0786017N

Measurement Methods

Parameter	Units	Measurement methods
p^H		**Portable Water Quality Checker (Horiba U-10)**
EC	mS/cm	
Turbidity	**(NTU)**	
Temperature	**(^{0}C)**	
DO	mg/l	Winkler Method
BOD	mg/l	
COD	mg/l	Dichromate reflux method (Open)
D.Lead Chromium	mg/l	Atomic Absorption Spectrophotometer
Chloride	mg/l	Titrametric method
Nitrate	mg/l	Chromotropic Acid Method
Phosphate	mg/l	Ascorbic Acid Method
Microbiological Condition	MPN/100 ml	MPN Method

Proposed Ambient Water Quality Standards

Parameter	Standard Value
pH	6.0-8.5
Turbidity	5 NTU
Dissolved Oxygen	6 mg/l
Biochemical Oxygen Demand	3 mg/,
Chemical Oxygen Demand	15 mg/l
Nitrate	5 mg/l
Phosphate	0.7 mg/l
Faecal Coliform	600 MPN
Dissolved form of heavy metal in water such as Chromium and lead	0.05 mg/l

- WQI were evaluated
  - with respect to the parameters having standards which indicate both industrial and domestic sources of pollutants for all sampling locations.
  - With respect to the parameters having standards by excluding the contribution of domestic sources such as Turbidity and Feacal Coliform..

Canadian Water Quality Index

Scope - F_1 = $\frac{\text{Total NO of Failed Parameters test X 100}}{\text{Total No of Test}}$

Frequency F2 = $\frac{\text{NO of Failed Test X 100}}{\text{Total No of Test}}$

Total No of Test = Total No of Parameter X Frequency

Amplitude of Excursion F3 = nse/0.01 (nse)+0.01

Excursion = [Filed Test Value- Objectives]- 1

nse = € Excursion /Total No of tests

Water Quality index = $100 - (\text{Sqrt}(F1^2 + F2^2 + F3^2) / 1.732)$

Eg -Calculation of WQI For Kiridivita

Scope - F_1 = $\frac{4\ (DO\ ,Turbidity,\ BOD\ ,\ FC)X\ 100}{11}$ = 36.4

Frequency F_2 = $\frac{33\ X\ 100}{165}$ = 20

Total No of Test = 11 X 15 = 165

F_3 = 59.6

Excursion = 243.6

nse = 1.476141

Water Quality index = 58.06146

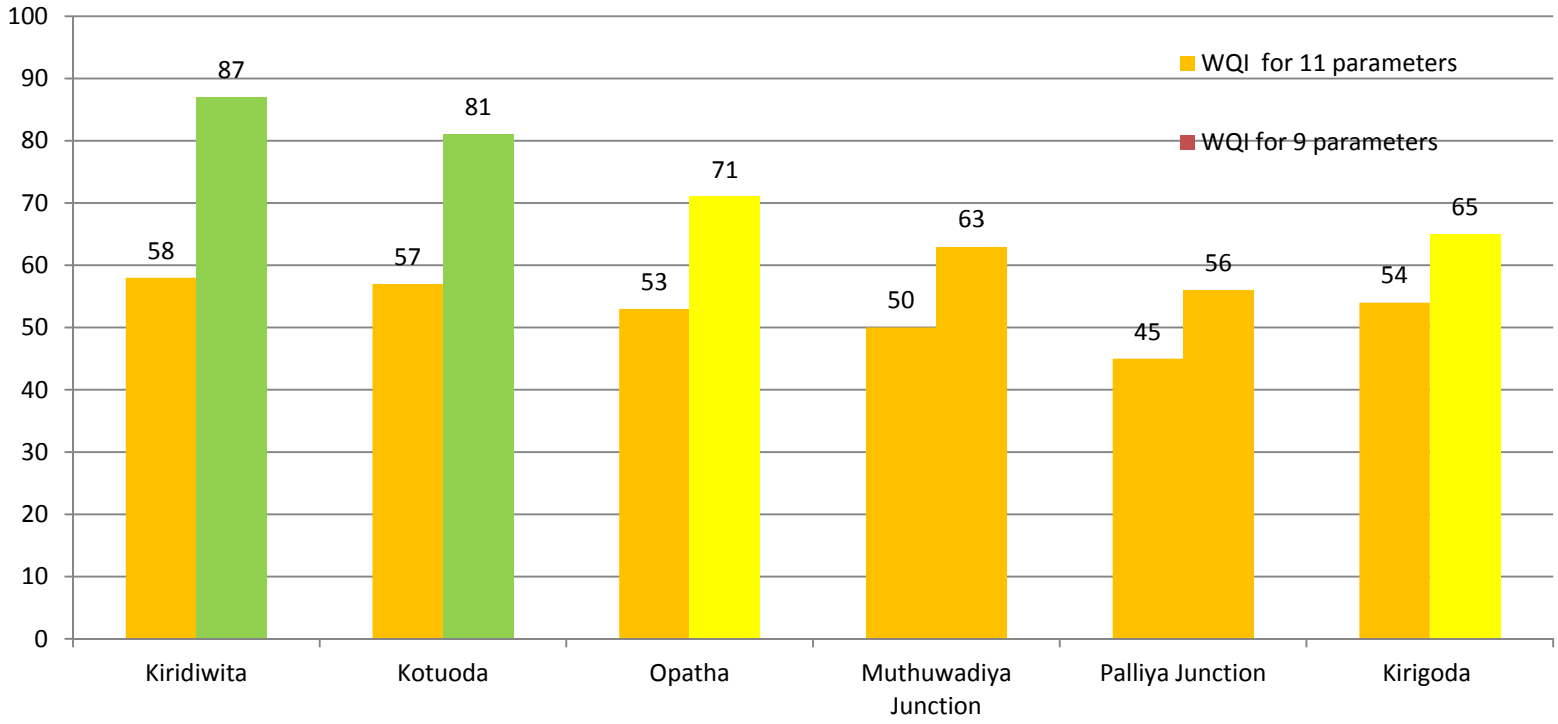
Water Quality Indexes with respect to 11 parameters

Sampling Location	Index Value	Ecological Condition	Color Code	Grade
Kiridivita	58	Poor	Orange	D
Kotugoda	57	Poor	Orange	D
Opatha	53	Poor	Orange	D
Muthuwadiya Junction	50	Poor	Orange	D
Palliyawatte Junction	45	Poor	Orange	D
Kiridigoda	54	Poor	Orange	D

Water Quality Indexes with respect to 9 parameters

Sampling Location	Index Value	Ecological Condition	Color Code	Grade
Kiridivita	87	Good	Orange	B
Kotugoda	81	Good	Orange	B
Opatha	71	Fair	Yellow	C
Muthuwadiya Junction	63	Poor	Orange	D
Palliyawatte Junction	56	Poor	Orange	D
Kiridigoda	65	Fair	Yellow	D

Graphical representation of WQI



Results and Discussion

- The WQI is gradually decreases up to 45 toward the downstream direction of the Dadugam Oya. Ecological condition of the water is poor a ((WQI 45 -64)
- The highest WQI at Kiridiwita (58) and second highest (57) was recorded at the sampling location Kotugoda .
- The main sources of pollutants is vary from domestic to industrial toward the down stream.
- Dadugam oya is not satisfactory with respect to all parameters.
- Turbidity & the microbiological contaminant are always exceeded.

- Mid stream site to down stream indicate the evidence of the industrial pollution .It is clearly indicated from Opatha to downstream.
- The gradual decrease of DO & increases of COD increases in water from downward from Opatha
- Seasonal Fluctuation of the low and high flow rates of the year for all pollutant indicators could be observed
- Increase of D. chromium (from the level of 0.01 mg/l to 0.04 mg/l) could be observed from Opatha to downstream from August 2012.

- Nutrient such as nitrate and phosphate are always below the standards proposed by the Central Environmental Authority
  - Upstream water does not shows any evidence of the industrial pollution.
- Significant difference could be observed between the values obtained during the low and high flow rates of the year for all pollutant indicators.
- COD for the latter stretch is comparatively higher than the standard value for most of the times.
- The WQI evaluated excluding turbidity and faecal contaminant clearly shows that the domestic sources are more prominent in the upstream site than the downstream. (Kiridiwita (87%) and Kotugoda (81%)

- Down stream water quality mainly deteriorated due to the industrial pollution Domestic sources are not most prominent in down

Conclusion

- Over all results of this research work indicated that the indexes are reflex of the real data as they demonstrate strong co relation to no of parameters include with the calculation
- Immediate measures has to be taken to control the further deterioration of the water quality of Dudugam Oya

Acknowledgement

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