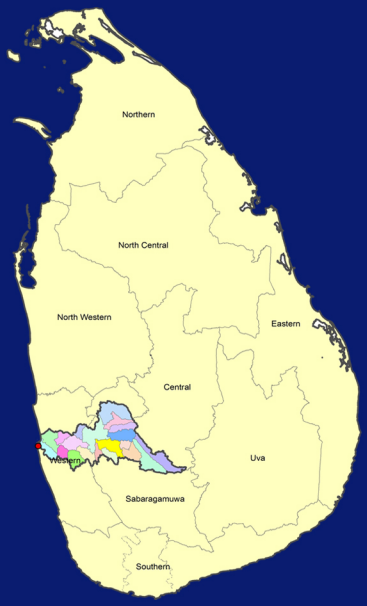
Final Report



Medium to Long-term Multi-stakeholder Strategy and Action Plan for Management and Conservation of the Kelani River Basin

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Medium to Long-term Multi-Stakeholder Strategy and Action Plan for Management and Conservation of the Kelani River Basin 2016-2020

January 2016

Medium to Long-term Multi-Stakeholder Strategy and Action Plan for Management and Conservation of the Kelani River Basin was developed by the Central Environment Authority (CEA) and International Union for the Conservation of Nature (IUCN) Sri Lanka Country Office with the participation of a large number of stakeholder groups.

Scope of this publication has been enriched as a model for managing catchments and river basins in support of Water Safety under the National Pavithra Ganga (Clean River) programme of the Ministry of Mahaweli Development and Environment with the technical inputs from the Ministry of City Planning and Water Supply, and United Nations Children's Fund (UNICEF).

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Dr. Ananda Mallawatantri
Mr. Ajith Rodrigo
Ms. Kushani De Silva

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Project Team

Central Environment Authority (CEA)

Mr. K. H. Muthukudaarachchi, Director General – Guidance and Coordination
Mr. U. K. D. G. Jayasinghe, Deputy Director General - Quality Assurance and liaison
Mr. Ajith Rodrigo, Director – CEA Project Coordinator and editorial and review inputs
Ms. Wasantha Wijesinghe, Director, Water quality data
Ms. W.M.P. Gunathilaka, Deputy Director, Review inputs
Ms. C.H. Edussuriya, Assistant Director - GIS maps and data
Ms. G.D.P.N. Chathurika, Senior Environmental Officer - Coordination and quality assurance
Ms. H. P. Hansika Dulanjalee, Environmental Officer - Coordination support

International Union for Conservation of Nature (IUCN) Sri Lanka Country Office

Dr. Ananda Mallawatantri, Project Leader – Design, formulation and authoring
Ms. Kushani De Silva, Project Coordinator – Coordination, compilation and edit support
Ms. Sandamali Pathirage, Project Assistant - GIS mapping, data and visualizations
Ms. Dinithi Samarathunga, Project Assistant – Water quality and project support

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Stakeholder Agencies and Representatives

In the development of the Medium to Long-term Multi-Stakeholder Strategy and Action Plan for Management and Conservation of the Kelani River Basin, 2016-2020.

	Agency
1	Ministry of Mahaweli Development & Environment
2	Ministry of City Planning & Water Supply
3	Ministry of Land and Land Development
4	Ministry of Plantation Industries
5	Ministry of Local Governments and Provincial Councils
6	Ministry of Health, Nutrition and Indigenous Medicine
7	Ministry of Education
8	Ministry of Provisional Council and Regional Development
9	Central Environment Authority (CEA)
10	National Water Supply and Drainage Board (NWSDB)
11	Land Commissioners Department (LC)
12	Department of Forest Conservation (FD)
13	Land Use Policy Planning Department (LUPPD)
14	Mahaweli Authority of Sri Lanka (MASL)
15	Survey Department (SD)
16	Coast Conservation and Coastal Resources Management Department (CC&CRM)
17	National Planning Department (NPD)
18	Irrigation Department (ID)
19	Department of Agriculture (DoA)
20	National Physical Planning Department (NPPD)
21	Geological Survey and Mines Bureau (GSMB)
22	Department of Wildlife Conservation (DWC)
23	Department of Agrarian Development (DAD)
24	Forest Department (FD)
25	Natural Resources Management Centre of Department of Agriculture (NRMC)
26	Western Province Solid Waste Management Authority (WPSWMA)
27	National Aquatic Resource Research and Development Agency (NARA)
28	National Building Research Organization (NBRO)
29	Water Resources Board (WRB)
30	Sri Lanka Land Reclamation and Development Cooperation (SLLRDC)
31	National Gem and Jewelry Authority (NGJA)
32	Board of Investment (BOI)

33	Ceylon Electricity Board (CEB)
34	Ceylon Petroleum Cooperation (CPC)
35	Road Development Authority (RDA)
36	National Cleaner Product Center (NCPC)
37	National Institute of Education (NIE)
38	Public Interest Law Foundation (PILF)
39	Reduce Risks from Invasive Species Coalition (RRISC)
40	Atomic Energy Authority (AEA)
41	Sri Lanka Navy (SLN)
42	Sri Lanka Police (SLP)
43	Sri Lanka Tourism Development Authority (SLTDA)
44	Tea Research Institute (TRI)
45	International Water Management Institute (IWMI)
46	Business and Biodiversity Platform of the Ceylon Chamber of Commerce
47	University Staff (Open University, Univ. of Colombo, Univ. of Sri Jayewardenepura)
48	Representatives of Media Agencies
49	Staff of District Secretariats
50	Staff of Divisional Secretariats
51	Grama Niladhari officers attached to District Secretariats
52	Representative of Environment Pioneer Programme (CEA, Principals and Teachers)
53	Public Health Officers
54	Divisional Environment Officers
55	Industry Representatives
56	Local Non-Governmental Organization Representatives
57	Representatives of Community Based Organizations
58	World Health Organization (WHO)
59	United Nations Children's Fund (UNICEF)
60	International Union of Conservation of Nature (IUCN)
61	United Nations Development Programme (UNDP)
62	Japan International Cooperation Agency (JICA)

Water …..

“Water is the driving force of all nature.” - Leonardo da Vinci.

“Water is essential for all dimensions of life. Over one billion people lack safe water, and three billion lack sanitation; eighty per cent of infectious diseases are waterborne, killing millions of children each year. The costs of water infrastructure have risen dramatically.” - World Bank Institute, 1999.

“High quality water is more than the dream of the conservationists, more than a political slogan; high quality water, in the right quantity at the right place at the right time, is essential to health, recreation, and economic growth.” – Edmund S. Muskie, U.S. Senator, speech, 1 March 1966.

“In every glass of water we drink, some of the water has already passed through fishes, trees, bacteria, worms in the soil, and many other organisms, including people...Living systems cleanse water and make it fit, among other things, for human consumption.” - R.J. Hoage, Animal Extinctions, 1985.

“Wetlands have a poor public image.... Yet they are among the earth's greatest natural assets... mankind's waterlogged wealth.” – Edward Maltby, Waterlogged Wealth, 1986

"For in the true nature of things, if we will rightly consider, every green tree is far more glorious than if it were made of gold and silver." - Martin Luther King

“Make friends with nature by working in harmony with her and she will make friends with you.” - Emmet Fox, *Make Your Life Worth While*

Foreword

The Kelani River Basin and its sustainability is of paramount importance to the human health of greater Colombo and Western Region populations, socio-economics and ecosystem stability of the country. The challenges posed by the land based, urban and industrial point and non-point source pollutions in the Kelani River Basin attracted the attention of multiple agencies and interest groups involved in development, conservation, health and human rights. These interests resulted in the development of the "Medium to Long-term Strategy and Action Plan for management and conservation of the Kelani River Basin" as an urgent and relevant measure.

The motivation of the Sri Lankan agencies exhibited during the consultations is a good indication that the current challenges and threats faced by the Kelani River Basin are not insurmountable nor beyond our control. As the name implies, the Medium to Long-term Multi-Stakeholder Strategy and Action Plan for Management and Conservation of Kelani River Basin is truly a multi-sector and a multi-stakeholder participatory approach based on science, empowerment and participation.

The issues identified and solutions listed in this plan takes a holistic partnership approach. This initiative is expected to follow a number of recent successful multi-stakeholder partnership approaches. Two such examples are the Sri Lanka Clean Air Initiative (over 50 partners) which is acclaimed as one of the best air quality programmes in Asia and Integrated Strategic Environment Assessment for the Northern Province – ISEA North (over 30 national agencies) that has been identified as a global model by the UN and the UNEP for post-conflict land use planning and locally adopted by the Ministry of Megapolis and Western Region Development for its Sustainability Framework.

This strategy and action plan takes a mix of top-down and bottom-up programming approaches coupled with Public-Private Partnerships. This combination approach and the decentralization of pollution control down to seventy-one (71) minor-watersheds are the innovative angles introduced in the design to promote knowledge, participation and ownership of all stakeholders including communities and private sector.

Implementation of this Strategy and Action Plan will be the first systematic river basin pollution management effort in the country. Also it will be the pilot integrated approach model for the National Pavithra Ganga (Clean River) Programme led by the Ministry of Mahaweli Development and Environment with the participation of a number of stakeholder groups. This report is accompanied by three other documents, namely, the Preliminary Perception Survey Report, Natural Resource Profile of Kelani River Basin and a Map Compendium of the Kelani River.

This locally grown model based on Sri Lanka technical agency experience supported with international knowledge belongs to everyone. Once implemented this medium to long-term strategy and plan will serve as a project that provides a sustainable balance between economic growth and conservation leading to stability and resilience of the country, while saying "yes" to development but ensuring "conservation."

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Glossary of Terms

Absorption - The uptake of water, other fluids, or dissolved chemicals by a cell or an organism (as tree roots absorb dissolved nutrients in soil.)

Adsorption - Removal of a pollutant from air or water by collecting the pollutant on the surface of a solid material; e.g., pesticides, fertilizer or heavy metal residues can get adsorbed onto clay and organic matter particles in eroded sediments and travel along with sediments into river and later desorbed (opposite of adsorption) into water and then to food chain.

Best Management Practices (BMPs) - A set of practices used to reduce impacts from a particular land use.

Biodiversity (biological diversity) - The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part

Catchment -The area from which precipitation contributes to the stream flow from a spring, river or lake. For rivers and lakes this includes tributaries and the areas they drain.

Ecological Risk Assessment - The application of a formal framework, analytical process, or model to estimate the effects of human actions(s) on a natural resource and to interpret the significance of those effects in light of the uncertainties identified in each component of the assessment process. Such analysis includes initial hazard identification, exposure and dose-response assessments, and risk characterization.

Ecosystem - A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit

Effectiveness monitoring - Documents how well the management practices meet intended objectives.

Hazard - One that would likely result in unreasonable adverse effects on humans or the environment or risk unreasonable hazard to an endangered species before any mitigation action can takes place

Impairment - A detrimental effect on the physical and chemical and biological integrity of a water body caused by an impact that prevents attainment of the designated use.

Landscape - An area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors

Load - The transfer of material, dissolved or particulate, associated with a flow of water.

Non-point source pollution - A pollution originating from discrete points (exact place of origin not clear) such as pipe discharge. Areas of fertilizer and pesticide applications, atmospheric deposition, manure, and natural inputs from plants and trees are examples of non-point source pollution.

Point source pollution - A source identified with a discrete origin such as a discharge pipe, drainage ditch, well, or concentrated livestock operation.

Quality assurance - A system of procedures, checks, audits, and corrective actions to ensure that activities, studies, research and performance, environmental monitoring and sampling, and other technical and reporting activities are of the highest achievable quality.

Threshold/tipping point - A point or level at which ecosystems change, sometimes irreversibly, to a significantly different state, seriously affecting their capacity to deliver certain ecosystem services.

TMDL process - The approach to develop pollution management and control in a particular waterbody or watershed. This process consists of five activities, including selection of the pollutant to consider, estimation of the waterbody's assimilative capacity, estimation of the pollution from all sources to the waterbody, predictive analysis of pollution in the waterbody and determination of total allowable pollution load, and allocation of the allowable pollution among the different pollution sources in a manner that water quality standards are achieved.

Total Maximum Daily Load (TMDL) - An estimate of the pollutant concentrations resulting from the pollutant loadings from all (both point and non-point) sources to a waterbody. The TMDL is used to determine the allowable loads and provides the basis for establishing or modifying controls on pollutant sources.

Watershed - A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river or lake at a lower elevation.

Water quality standards – Standards used to ensure the quality of water in water bodies in relation to given uses. The components of water quality standards include the beneficial designated use or uses of a water body (for example, drinking water supply, contact recreation (swimming), and aquatic life support), the numerical and narrative water quality criteria that are necessary to protect the use or uses of that particular water body.

Wetland - Land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, water-loving vegetation, and various kinds of biological activity which are adapted to a wet environment.

List of Abbreviations

BOBLME	-	Bay of Bengal Large Marine Ecosystems Project
BMP	-	Best Management Practices
CEA	-	Central Environment Authority
CEJ	-	Centre for Environmental Justice
CC&CRM	-	Coast Conservation and Coastal Resource Management Department
DCS	-	Department of Census and Statistics
DWC	-	Department of Wildlife Conservation
EPB	-	Environment Pioneer Brigades Programme of CEA
FD	-	Forest Department
GRI	-	Global Reporting Initiative
GSMB	-	Geological Survey and Mines Bureau
IESL	-	Institute of Engineers of Sri Lanka
IFC	-	International Finance Corporation of the World Bank
ISO	-	International System of Standards
IUCN	-	International Union for the Conservation of Nature
IWMI	-	International Water Management Institute
JICA	-	Japan International Cooperation Agency
KRB	-	Kelani River Basin
KRBP	-	Kelani River Basin Plan
KRMP	-	Kelani River Multi-Stakeholder Partnership
KWDP	-	Kelani River Water Diplomacy Platform
LUPPD	-	Land Use Policy Planning Department
MEPA	-	Marine Environment Protection Authority
NARA	-	National Aquatic Resources Research and Development Agency
NATURE +	-	Nature Based Solutions (IUCN)
NBRO	-	National Building Research Organization
NCPC	-	National Cleaner Production Centre
NWSDB	-	National Water Supply and Drainage Board
REDD	-	Reducing Emissions from Deforestation and Forest Degradation
R&D	-	Research and Development
SDGs	-	Sustainable Development Goals
SLRDCC	-	Sri Lanka Land Reclamation and Development Corporation
STORET	-	USEPA data Storage and Retrieval System
SWOT	-	Strengths, Weaknesses, Opportunities and Threats
TEEBS	-	The Economics of Ecosystem Based Services (IUCN)
UNDP	-	United Nations Development Programme
UNDP/EDM	-	Every Drop Matters Project of UNDP
UNEP	-	United Nations Environment Programme
UNICEF	-	United Nations Children's Fund
USEPA	-	United States Environment Protection Agency
WHO	-	World Health Organization
WRB	-	Water Resources Board
WRMP	-	Western Region Megapolis Plan

Executive Summary

Background: Kelani River Basin provides a range of services and economic benefits. Its continued ability to do so is being challenged by industrial, urban, agricultural and other man-made point and non-point pollution. The Kelani River Multi-Stakeholder Partnership (KRMP) is an approach leading to develop and implement a ***"Medium- to Long-term Strategy and Action Plan for the Management and Conservation of the Kelani River Basin."*** The purpose of the approach is to ensure the resilience and sustainability of Kelani River Basin and its services, including biodiversity and climate resistance. A sense of urgency is indicated in the proposed plan based on the fact that if the Kelani River is polluted beyond recovery it affects the entire country in multiple ways beyond the supply water and has the potential to create a health disaster and unemployment.

Approach: The KRMP takes a pro-active, comprehensive, yet a balanced approach in order to save the river basin ecosystem while maintaining its socio-economic base. It may require promotion of alternative employment options other than industrial and policy measures on land use, industrial and urban management. Improvements on technology, water quality monitoring, enforcement, land use changes and advocates the use of nature, culture, and heritage based income generation are the broad intervention angles proposed.

The KRMP strategy appreciates and captures the increased attention shown by public on health issues related to water and the critical importance of a long-term water safety approach. As a result, prominence is given to protect the catchment to minimize the risks of ***"slow onset diseases and potential chemical, industrial, urban and other pollution related accidents in the basin."***

Project Design: The Medium to Long-term Strategy and Action Plan includes improvements to policy, institutional and implementation gaps identified and includes 65 well-defined initiatives worth over 50 million USD for five years. To facilitate the management, implementation and monitoring the action plan was designed to have five Management Objectives (MOs) and ten (10) Key Results Areas (KRAs).

Management Objective A:	Land use management for source water protection and sustainability
Management Objective B:	Industrial and Urban Management for Pollution Control and Sustainability
Management Objective C:	Research, Awareness, Training and Education for Better Management and Conservation
Management Objective D:	Operationalizing, Monitoring and Evaluation
Management Objective E:	Public Private Partnerships contributing towards the sustainability of Kelani River Environment

While the activities under these five MOs and ten KRAs cover all 17 Sustainable Development Goals (SDGs) the project is designed to have three operational levels of implementation. First level is by the technical agencies in charge of different sectors such as pollution control, water supply, agriculture, mining, health, disaster management, infrastructure etc., covering policy, institutional and implementation barriers identified during the consultations and captured in the work plan. These agency programmes may cover larger regions or the entire Kelani River Basin.

The second level are the ***"public-private partnerships"*** by strengthening the ongoing initiatives (electronic waste, paper recycling, m-waste etc.) while adding a range of innovative programmes. These partnerships may cover the entire basin (eg: Hazardous waste removal and disposal, education and

awareness, reuse, recycle etc.) or focus on local or ***"minor-watershed level"*** (71 minor watersheds in the basin) based on the need and interest of the private sector facilitated by the public sector.

The third or the minor-watershed level programmes are based on the ***"local pollution issues."*** in 71 minor watersheds. The minor watershed approach is informed by linking water quality monitoring results in the watershed with pollution source knowledge of stakeholders. (e.g.: E. coli from leaking toilets; heavy metals from industry; solid waste and wastewater from restaurants and households etc.). Once the minor-watershed level issues are identified and the level of pollution or the **impairment** status of the minor-watershed is known, the proposed ***"minor-watershed level stakeholder work groups"*** are expected to develop and implement management plans.

These local groups may involve industries and business in the area, local authorities, health workers, community organizations, private entities, schools etc., providing an innovative approach on decentralized pollution control and management. Planning and implementation of local initiatives will be assisted through technical agencies, universities and others by way of training, awareness and technologies (compositing, biogas, constructed wetlands, rainwater harvesting, etc.), best management practices (recycling, low-input farming, waste minimization etc.). Proposed Public Private Partnerships (PPPs) are expected to play a major role at this level. CEA along with other Govt. Agencies are entrusted with the responsibility of quality assurance in the design and implementation of minor-watershed projects preferably though the Total Maximum Daily Loading (TMDL) approach proposed.

Operational Arrangement and Support Programmes: The proposed coordination of the KRMP approach is through a dedicated *"Steering Committee"* comprising of about 20 members chaired by the Ministry in Charge of Environment and Co-Chaired by the Ministry in Charge of Water Supply. To provide the much needed technical direction five *"Technical Sub-Committees"* under each Management Objective area is proposed. A ***"Secretariat"*** will support the overall management of the project and promote a number of tools including a communication strategy, content management system, a monitoring and evaluation framework supported by a baseline development and updating system, web and social media approaches, among other things. In addition, the Secretariat will ensure that the KRMP approach is in sync with other national priority programmes, conventions etc.

A range of assessments, research and studies are proposed such as health-economic links, cost and benefits of certain practices (high focus on polluting industries, use of nature base employment, climate change impacts, modelling of river basin environmental process etc.). In addition, basin wide campaigns and enhanced communication efforts will add value. For example, one of the proposed efforts are on the line of "Healthy River-Healthy People." These additional inputs will help the KRMP approach to be at the cutting edge in promoting science based decision making, participatory approaches and better land use.

Strengthened water quality monitoring effort proposed including estimation of pollutant loads into water bodies and monitoring of the effectiveness of the best practices at sub and minor-watershed scales with higher emphasis on ground water will provide the necessary holistic nature to the programme.

KRMP approach intends to invest on baseline establishment and regular updates to provide the programme a scientific and lessons learnt. The periodic monitoring of the project will be conducted using the proposed M&E approach where results of activities are aggregated upwards to Key Results Areas, Management Objectives and Impact (outcome). The project may also provide opportunities for enhanced university, international, industry, research and community linkages plus the options for capacity building by students, interns and graduate students.

Chapter 01: Introduction

1.1.Kelani River Basin

The Kelani River drains an area about 2,300 square kilometres and the basin is rich with biodiversity and natural resources. It is the home for more than 25% of Sri Lankans. The Kelani River starts near the Adams Peak and Kirigalpotta areas (about 2,200 meters above mean sea level) in central hills and drains via Kithulgala, Avissawella through flood plains ending with the Colombo outfall into the Indian Ocean.

Kelani River is the primary source of drinking water to millions of people in Greater Colombo. Over 10,000 industries and business, providing a vast number of employment opportunities, are located within the Kelani River Basin. The ecosystem of the Kelani River Basin supports socio-economic activities such as agriculture, mining, urban development, industrial development, tourism and power generation, among other things. The water needs for drinking, environmental services and others from Kelani River will increase continuously as Greater Colombo and the Western Region grow. According to the Western Province Megapolis Plan (WRMP) Western Region population is expected to grow up to about 8.0 million by 2030 from present 6.0 million.

The river basin experiences an annual average rainfall of about 3,450 mm corresponding to a volume of about 7,860 million cubic meters (MCM) out of which nearly 43% discharges into the Indian Ocean (Survey Department, 2007).

The basin contains some of the most picturesque landscapes in Sri Lanka, offering a high potential to be developed as tourist destinations (Red Dot Tours, 2015 and Gordon, 2014), probably offering an alternative to the present industrial based economy.

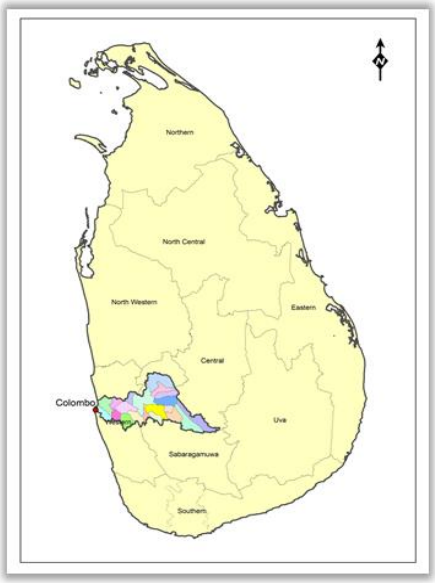

Figure 1: Kelani River Basin

Lowland, Submontane and Montane forests that are located in the middle and upper reaches of the Kelani River Basin are inhabited by a large number of endemic and threatened plants and animals (Jayasuriya et.al., 2006 and Perera et. al., 2014).

At the same time the Kelani River is known for its increasing pollution as a result of industrial discharges, poor local authority service delivery, weak environment management and governance (Arewgoda, 1986; Illeperuma, 2000; and CEA, 2014) coupled with inadequate awareness and education (Mallawatantri and De Silva, 2016). The envisaged climate impacts require urgent attention on the way we manage and use the natural resource base including ground and surface water resources.

Presently the National Water Supply and Drainage Board (NWSDB) provide treated drinking water from the source water from Kelani River. However, the treatment processes depend on the quality of the source or “raw” water. Ensuring source water quality and quantity need protection of catchment

ecosystems and minimize adverse human actions that cause pollution of water resources, primarily through industrial, urban, agricultural and infrastructure sectors.

Over the years, a large number of agencies have attempted to improve the Kelani River Basin health and sustainability. As a result, a vast amount of information has been generated. It is possible to integrate the available information and past experience towards a large initiative along with global experience on river basin restoration to benefit the future efforts of making the Kelani River Basin sustainable and resilient.

1.2.Partnership approach

Due to the complexity and cross cutting nature of the issues related to Kelani River Basin (KRB) *a multi-sector, multi-agency and multi-stakeholder approach* is envisaged to ensure the long-term sustainability and resilience of the Kelani River Basin and its ecosystem services. The concept of **"Kelani River Multi-Stakeholder Partnership (KRMP)"** approach is developed as a pilot initiative under the National Pavithra Ganga (Clean River) Programme. KRMP will include a long-term action plan with specific roles and responsibilities for different agencies, groups and individuals.

1.3.Water safety

Not all water borne disease make us sick immediately. In some instances, especially the heavy metal or agrochemical contamination related sicknesses are known to have a slow-onset. Often it is difficult to link the diseases to a particular source of pollution and symptoms develop gradually over a longer period and reflect as cancer, kidney problems etc.

Sickness make people less productive or unproductive. The costs of health individually or as a nation include lost work, quality time and money spent towards obtaining medicine (often foreign exchange). The opportunity costs billions of rupees in foreign exchange spent on imported drugs along with local costs plus deteriorating quality of lives of affected and family is of a serious concern for national level decision making.

Water safety, therefore, is a relevant and convincing entry point for management and conservation of the Kelani River Basin. Once in the process will not only minimize the health impacts through polluted drinking water but also has a number of ecosystem and socio-economic benefits.

WHO water safety approach involve?

- Drinking-water safety including minimum procedures and specific guideline values along with intended uses of guidelines.
- Considers microbial hazards, which continue to be the primary concern in developing and developed countries therefore the need of a systematic preventive approach on microbial safety.
- Ensures the microbial safety of drinking water through a multiple-barrier approach, highlighting the importance of source water protection.
- Climate change, which results in changing water temperature and rainfall patterns, severe and prolonged drought or increased flooding, and its implications for water quality and water scarcity.
- Recognizes the importance of managing impacts as part of water management strategies and guidance on identifying local priorities for management.
- Includes chemical contaminants in drinking-water, including information on chemicals not considered previously, such as pesticides used for vector control in drinking water.
- Updates to fact sheets with new scientific information on key chemicals responsible for large-scale health effects through drinking water exposure, including arsenic, fluoride, lead, nitrate, selenium and uranium.
- Emphasis on the important roles of different stakeholders in ensuring drinking-water safety and the need to recognize different responsibilities of key stakeholders in ensuring drinking-water safety.
- Provides guidance in situations other than traditional community supplies or managed utilities, such as rainwater harvesting and other non-piped supplies or dual piped systems.

Source: WHO (2011)

Fourth edition of the guidelines for drinking water quality developed by WHO in 2011 articulates a comprehensive preventive risk management approach for ensuring drinking-water quality. WHO guidelines are also accompanied risk assessments for specific

chemicals, drinking-water quality and surveillance and control of community supplies (WHO, 2011).

The KRMP approach uses water safety planning at basin and minor-watershed (71 numbers) to ensure the safety through catchment protection while highlighting the multiple socio-economic benefits as a result of improved ecosystem services. This stepwise approach covers understanding the risks at basin, sub-basin, and minor-watershed levels and adopting Best Management Practices (BMPs) to mitigate the risks, involving multiple partners and stakeholder groups.

1.4.Water quality status

A limited amount of information is available on the type and quantities of pollutants to surface and ground water in the basin. Literature characterizes Kelani River as the most polluted river in the country (Ileperuma, 2000).

According to Arewgoda (1986) shallow dug well waters around Kelaniya, where a number of brass foundries are in operation, are contaminated with Pb (0.09 ppm), cadmium (0.06 ppm) and zinc (10.91 ppm). The mean urinary mercury level of families engaged in gold recovery was 0.51 ppm, which is significantly higher than in the control group where the mean level was 0.07 ppm (Ratnayake and Arewgoda, 1987).

CEA and NWSDB periodic water quality monitoring also indicates deterioration of water quality. According to CEA (2015) the quality of the river water at Thulduwa and Seethawaka ferry, influenced by industry, had inferior water quality with compared to the lower reaches of the river where dilution from good water from less disturbed watersheds occur. The parameters that are frequently exceeded standards were COD (37% times), BOD (13% times) Dissolved Oxygen (43% times) and Heavy metals (7% times). The quality of water at the two locations rapidly deteriorated during past three years with the Seethawaka ferry site receiving industrial wastewater from the Seethawaka industrial zone.

Sampling sites in the middle of the river basin such as Pugoda Ferry, Hanwella Bridge, and Kaduwela Bridge had a superior water quality compared to their upstream, primarily due to the dilution effects as the river receives water from tributaries towards the middle of the basin.

The highest Water Quality Index (WQI) was reported at Welivita and Pugoda Ferry with Welivita scoring a WQI of 68 while Seethawaka site recording a WQI of 51 (CEA, 2015). The WQI of the main tributaries such as Wak Oya, Pugoda Ela were in the range of 51-59 indicating poor ecological conditions (CEA, 2015).

Similarly, at the sampling site at Raggahawatte that receives contaminated industrial wastewater from Biyagama Industrial Zone exceeded standards during the last three years for COD (36% times), BOD (7% times), Dissolved Oxygen (27% times) and Heavy metals (7% times). In addition, the Ma Oya tributary reports discharges of organic waste with exceeding levels of COD (13% times), BOD (60% times), Dissolved Oxygen (80% times) and heavy metals (7% times), during the last three years.

The turbidity levels have often exceeded the standards in all sampling locations. Turbidity (which is a measure of the light -transmitting properties of the water) is a measure of the suspended particulate matter (clay, silt, fine organic matter etc.) in the water. The variation of turbidity depends on the extent of agricultural erosion, land degradation, mining activities, disturbances and urban runoff. Further the soil disturbances may also occur due to infrastructure (road, buildings etc.) development and stream bank destabilizations during rainy seasons.

Faecal coliform in river water is an issue at lower reaches and parts of upper reaches of the Kelani Basin where population density is high.

Poor sanitation practices, disposal of untreated or partially treated sewage (eg: from household latrines and restaurants/hotels located on the banks) and inadequate urban infrastructure (central pumping and treatment etc.) are some of the identified gaps.

During flood seasons, some of the septic tanks are flushed into the stream water. Addressing Faecal Coliform issue requires local level improved sanitation as well as investments at urban service delivery level, especially in highly populated areas.
Public living near Kelani River Basin reports gradual increases of pollution of the Kelani River with increased garbage and other debris floating in water plus kids experiencing skin issues after swimming in the Kelani River (Vipulasena, 2015).

Poor municipal waste management is a known issue throughout the country and Kelani River Basin is not an exception. Addition of electronic waste and other hazardous waste into the system poses an additional challenge to the local authority service delivery.

To ensure safe drinking water the NWSDB has already initiated twice-a-week laboratory tests on heavy metals such as cadmium, lead, arsenic and chromium.

Sediment management is one of the key areas for river basin restoration as sediments (clays and fine organic matter) have the ability to transport nutrients, metals and organic chemicals in adsorbed or absorbed forms and later release to water under certain temperature, ionic and other conditions.

A five year (2010-2015) estimate of the mass of sediments indicate that, on the average, about 2,300 metric tons of sediments passed by the Hanwella Bridge, annually (Mallawatantri and Samarathunga, 2016, unpublished). It also indicates a seasonal variation with high amounts of sediments in the river during rainy seasons. For example, the monthly load of sediments passing by Hanwella Bridge vary from is about 40 tons per month in February to about 725 tons per month in October, on the average.

Table 1: Sources and types of pollution

Source	Common Associated Pollutants
Agriculture	Turbidity, phosphorus, nitrates, temperature, total suspended solids
Forest disturbances	Turbidity, temperature, total suspended solids
Grazing land	Fecal bacteria, turbidity, phosphorus, nitrates, temperature
Industrial discharge	Temperature, conductivity, total solids, toxic substances (metals, radio-active), pH
Mining	pH, alkalinity, total dissolved solids, metals
Septic systems	Fecal bacteria (i.e., *Escherichia coli*, enterococci), nitrates, phosphorus, dissolved oxygen/ biochemical oxygen demand, conductivity, temperature
Sewage treatment plants	Dissolved oxygen and biochemical oxygen demand, turbidity, conductivity, phosphorus, nitrates, fecal bacteria, temperature, total solids, pH
Construction	Turbidity, temperature, dissolved oxygen and biochemical oxygen demand, total suspended solids, and toxic substances
Urban runoff	Turbidity, total suspended solids, phosphorus, nitrates, temperature, conductivity, dissolved oxygen and biochemical oxygen demand

(adopted from USEPA, 2008)

Based on the sediment load estimates at Hanwella Bridge monitoring station, it was calculated that on the average the annual sediment yield at Hanwella is about 12.7 kg per ha (using a drainage area of 182,200 ha and annual load of 2,330 tons). It was also noted that in high flow months like November (mostly due to rainfall) the monthly load can increase over 700 tons of sediments resulting in a sediment yield around 4 kg/month/ha in such high flow/erosion (rainfall) periods.

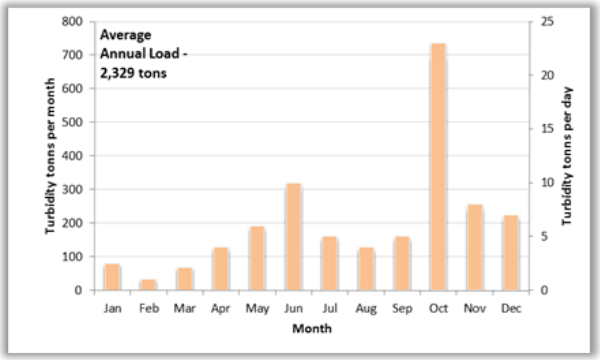

Figure 2: Average turbidity load by Hanwella Bridge
Source: Mallawatantri and Samarathunga (IUCN, 2016, unpublished)

Although these sediment yields taken on the average are not extraordinarily high there could be minor watersheds generating high amounts of sediments needing attention both in urban and rural settings. On the other hand, lack of data at other locations plus incomplete parameter coverage (e.g.: metals) do not allow for extensive load estimation and an analysis at this time (CEJ, 2015; Chapter 6 gap analysis and proposed enhanced monitoring).

1.5.Consultative strategic planning

Based on the above context it was necessary to formulate a strategy and action plans to balance socio-economics, development and conservation. In summary saying "Yes" to development while keeping "Conservation" in focus for the Kelani River Basin.

The proposed multi-sector and multi-agency participatory planning and implementation approach development or the Kelani River Multi-Stakeholder Partnership (KRMP) involved, Govt. Agencies, Private Sector, Non-Government entities, Universities, Researchers, Media, Communities and experts.

The understanding on pollution issues, barriers and potential solutions were gathered through consultations with stakeholder agencies, local and global literature, discussions with experts from state, private sectors and international agencies.

Key stakeholder consultative sessions were held between late 2013 and December 2015 and the main topics for each consultation are listed below.

1. Issues faced by Local Authorities (Mayors and members of Urban Councils and Local Authority members) on November 2013 at Ramada, Colombo (supported by UNDP)

2. Identification of water quality and quantity issues by Govt. Agencies on March 2014 at Ambathale, NWSDB auditorium (supported by UNDP)

3. Ongoing programmes by Govt. agencies on July 2014 at Hotel Galadari in Colombo (supported by UNDP)

4. Stakeholder workshop on potential solutions at Hector Kobbakaduwa Agrarian Research and Training Institute (HARTI) on September 2015 (supported by UNICEF)

5. Discussion on draft action plan at Waters Edge on October 2015 (supported by UNICEF)

6. Discussion on the implementation strategy at CEA on November 30, 2015 (supported by UNICEF)

In addition, to identifying the key issues the stakeholders were able to propose potential policy, capacity and implementation level improvements needed in the Kelani River Basin management and conservation. A number of other areas for improvements such as coordination, knowledge management and

enhanced awareness and education have been highlighted by agencies as cross cutting measures.

Based on the discussions, literature review and findings it was clear that it is necessary to develop a ***"Medium to Long-term Strategy and Action Plan for Management and Conservation of the Kelani River Basin"*** to address identified priority issues along with a range of capacity building measures.

The key technical areas/issues identified

1. Industrial Discharges
2. Poor land use practices leading to erosion and sedimentation
3. Over extraction of water, sand and gems
4. Inadequate consideration of socio economic benefits of ecosystem services in planning and investments
5. Unauthorized solid and liquid waste releases to land and water bodies
6. Inefficient handling of electronics waste, unused medicine and post-consumer waste
7. Unauthorized constructions and encroaching of river banks
8. Deforestation and forest degradation
9. Haphazard disposal of sewerage and lack of centralized facilities
10. Lack of disaster preparedness approaches to manage chemical accidents

Broadly, the proposed interventions covered four main technical areas, namely, the land use, industrial, urban service delivery and cross cutting issues such as climate change, gender and vulnerabilities.

The stakeholder discussions also brought in the need to work on multiple scales with a combination of bottom up and top down approaches to optimize the ability for multi-sector, multi-stakeholder groups to engage effectively.

These scales can be in number of forms such as geographic scales (river basin, sub-basin and minor watershed, district secretariat, GN, local authority etc.) or technology (large investments, best practices or simple environment management audits based corrections such as cleaner production). It was also necessary to formulate an operational mechanism to facilitate implementation, capacity development, knowledge management, local and international relations and monitoring and evaluations, among other things.

1.6. KRMP approach objectives

The overarching objective of the KRMP approach is to ensure the socio-economic and environmental sustainability of the Kelani River Basin through a medium to long-term Strategy and Action Plan.

Specific Objectives

1. Develop a medium to long- term strategy and action plan for management and conservation of KRB with specific roles and responsibilities articulated for agencies
2. Outline an implementation mechanism that involves multiple stakeholder groups including Govt., Non-Govt., Private Sector, Community and other interest groups
3. Develop a comprehensive support package including knowledge management, communication strategy, targeted research and development, recognition systems and a basin wide monitoring system to support the implementation of the multi-sector and multi-agency KRMP approach.

Chapter 02: Kelani River Basin Characteristics

2.1. Topography and geology

The topography of the basin includes three peneplains, namely, the first peneplain (lower and mostly flat), second peneplain (middle starting around 100 meters of elevation and extending to about 300 meters) and third peneplain (upper consisting of complex mountain chains, massifs and basins with different degree of erosion), as described in detail by Cooray (1984).

The Kelani River landform vary significantly and includes 11 landforms, namely, Mountain, Escarpment, Hill and Ridge, Ridge and Valley, Hill and Valley, Mantled Plain (gently undulating to rolling plains), Rock Knob Plain (rough and broken relief of extensive tracts), Erosional Remnant (isolated, steeply rising bedrock controlled hills and ridges), Flood Plain, Coastal Plain, Sand Dune and Beach (Cooray, 1984).

The River basin lies across in the Southwestern Group and the Highland Series. The Highland Series is "composed of metasediments and closely associated charnockite gneisses. The metasediments comprise quartzite, fine grained acid gneisses, granulite, calc gneisses, marble and type khondalite, which is a sillimanitic-garnet-graphite schist." The Southwestern Group "is made up of schists, gneisses, and granulites of metasedimentary origin, as well as migmatite and grantic gneisses. Both its lithology and metamorphic history differentiate it from the Highland series (Cooray, 1984 and Panabokke, 1996)

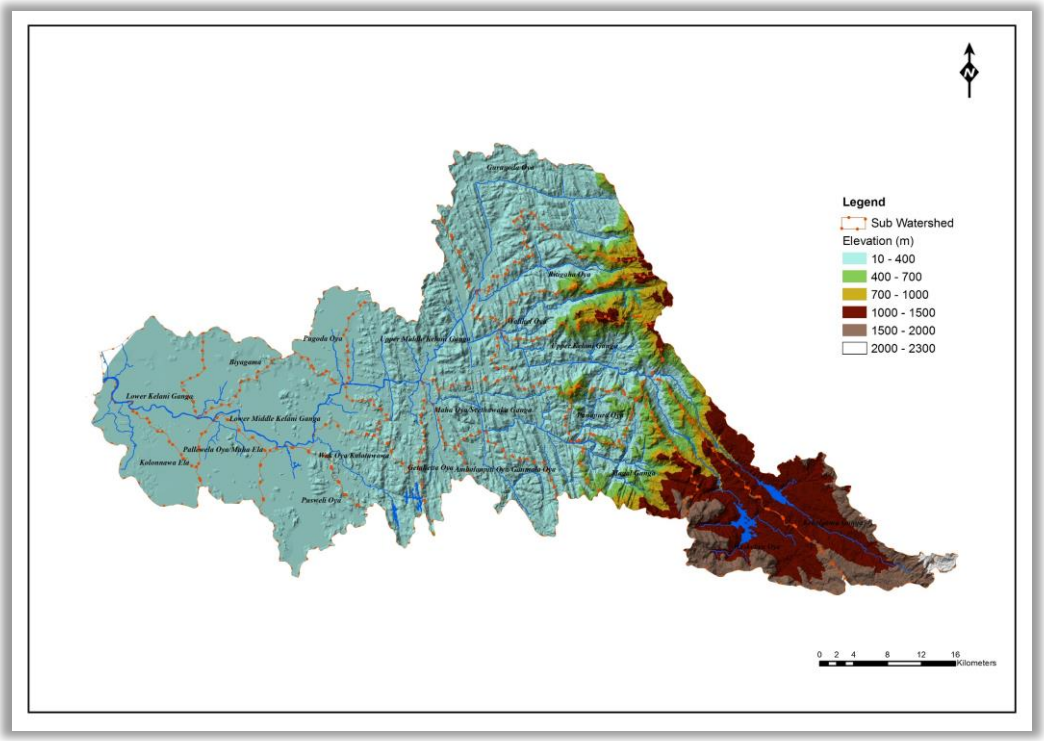

Figure 3: Topography of the Kelani River Basin
Source: Survey Department contour data

2.2. Sub-basins

The Kelani River is the third largest watershed in the country extending over three provinces, namely, Western, Sabaragamuwa and Central. It also covers administrative districts of Nuwara-Eliya, Kandy, Kegalle, Rathnapura, Gampaha, Kalutara and Colombo. Survey Department has divided the basin into 20 sub-basins. The sub-basins are of different sizes varying from about 4,000 ha to 120,000 ha.

There are 17 water supply schemes along the river which serve 80% of the people living in Colombo district. In terms of power supply two upland tributaries of the river, Maskeli Oya & Kehelgamu Oya help generate electricity with three dams one across Maskeli Oya and two dams in Kehelgamu Oya creating Maussakele, Canyon, Laxapana, Castlereagh and Norton reservoirs. The total generating capacity is 335 MW or 1,382 GWH per annum. Each sub-basin

Table 2: Areas under sub-basins

NO	Sub Watershed	Area(ha)	%
1	Kolonnawa Ela	8,597	3.68
2	Pallewela Oya/Maha Ela	6,146	2.63
3	Pusweli Oya	11,367	4.87
4	Wak Oya/Kalatuwawa	9,372	4.02
5	Getahetta Oya	4,327	1.85
6	Ambalanpiti Oya/Gonmala Oya	6,965	2.98
7	Maha Oya/Seethawaka Ganga	14,500	6.21
8	Panapura Oya	4,289	1.84
9	Magal Ganga	11,123	4.77
10	Maskeliya Oya	19,537	8.37
11	Kehelgamu Ganga	21,226	9.10
12	Upper Kelani Ganga	13,359	5.73
13	Walihel Oya	8,922	3.82
14	Ritigaha Oya	9,395	4.03
15	Gurugoda Oya	23,887	10.24
16	Upper Middle Kelani Ganga	23,977	10.28
17	Pugoda Oya	5,214	2.23
18	Lower Middle Kelani Ganga	12,780	5.48
19	Biyagama	6,174	2.65
20	Lower Kelani Ganga	12,178	5.22
	Total	233,335	100.00

Source: Survey Department 20 watersheds in Kelani River Basin

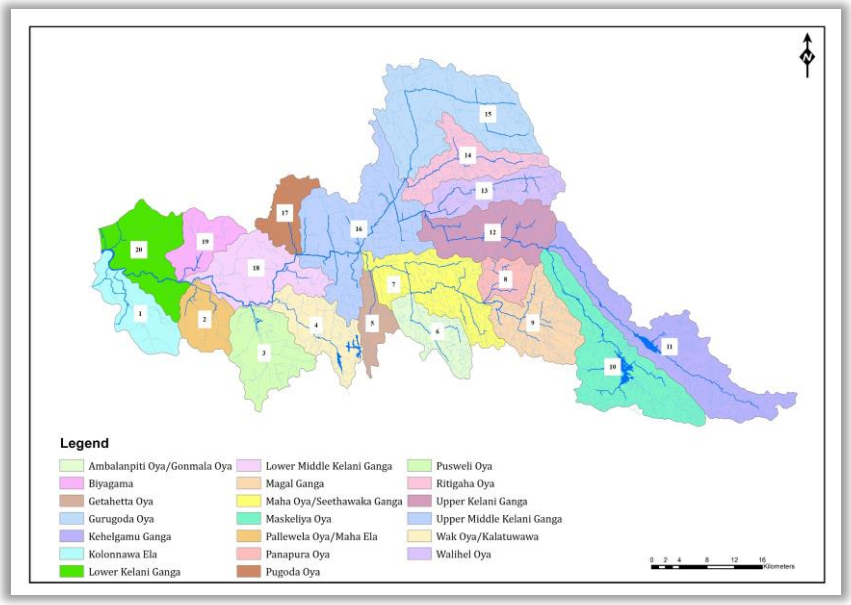

Figure 4: Twenty sub-basins in the Kelani River
Source: Survey Department

characteristic is different and the type of pollution sources may also differ. The main river is fed with tributaries and streams originating from sub-basins. During the proposed management and conservation, these sub-basins and tributaries will form the local level and will be considered independently based on the pollution sources assessment to be conducted early in the operationalizing of the KRMP approach.

2.3. River morphology

Kelani River related morphological characteristics indicates that it has a relatively drainage density of 1.788 km for square kilometre indicating lower permeability of the landscape leading in to higher runoff volumes. This is further indicated by a relatively high bifurcation ratio of the Kelani River Basin reported at 4.09 where flood peaks will be low but longer.

More morphological features:

Catchment Area:		2,292 sq. km
Perimeter	:	357 km
Axiel length	:	102 km
Basin width	:	22.5 km
Circular Ratio	:	0.23
Elongation Ratio:		0.53

Source: Survey Department (2007)

Table 3: Stream order characteristics

Steam Order	Number of streams	Mean length (km)
1	4,490	0.51
2	1,112	0.79
3	296	1.69
4	70	2.69
5	15	8.98
6	4	18.41
7	1	55.18

2.4. Provinces

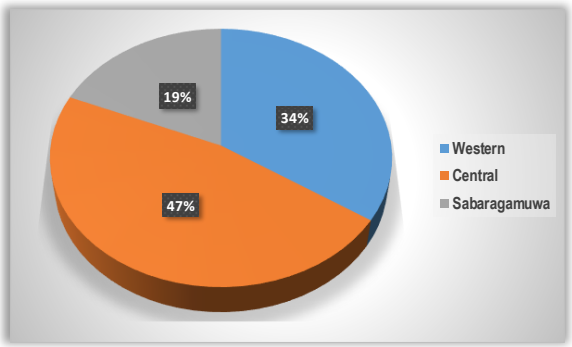

Figure 5: Areas under three Provinces

The Kelani River basin includes parts of three provinces out of nine provinces in the country. Western Province covers 34% of the basin with about 800 sq. km. Central Province with about 1,100 sq. km. covers about 47%, nearly half the basin area. The Sabaragamuwa Province with about 430 sq. km. covers 19%. As some of the decision making on a number of economic and service sectors are with Provinces the contribution of Provincial management is important in management and conservation of the Kelani River basin.

2.5. Districts

Seven out of 25 districts of the country are represented within the Kelani River Basin with Kegalle having the major share with about 44% of the total area located within the district. Each district is divided into a number of DS divisions and DS divisions are further divided into Grama Niladhari (Village level).

Out of the seven districts in the Kelani River Basin Kegalle districts represents the largest area with about 44% of the basin area located within the district. It is followed by Colombo (19%), Nuwara-Eliya (18.4%), and Gampaha (14.7%), respectively.

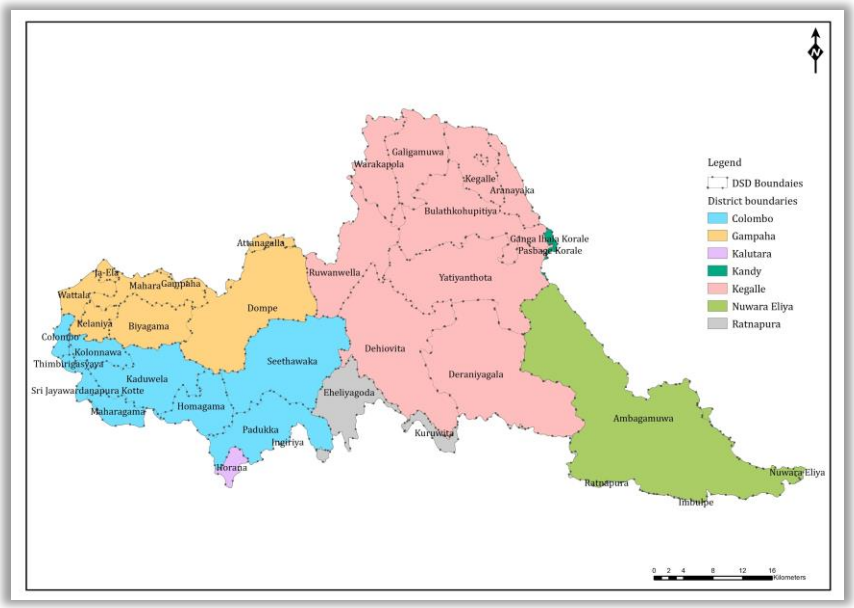

Figure 6: District and Divisional Secretariat boundaries
Source: Department of Census and Statistics

Table 4: Districts in the Kelani River Basin

District Name	Area (km^2)	(%)
Colombo	446	19.0
Gampaha	343	14.7
Kalutara	12	0.5
Kandy	4	0.2
Kegalle	1,028	44.0
Nuwara Eliya	430	18.4
Ratnapura	70	3.0
Total	2,333	100.0

During the KRMP approach both District Administration that include DS and GN levels, and Sub-basin levels will be considered based on the land use, pollution management and other initiatives, along with the local authority related administration presented earlier in the sub-watershed section.

This distribution also indicates the enhanced coordination required to implement a management and conservation approach covering the entire Kelani River Basin.

2.6. Local Authorities and Divisional Secretariats

There are 37 local authority areas within the Kelani River Basin comprising of three Municipalities (Colombo, Sri Jayewardenepura- Kotte and Kaduwela), five Urban Councils (Maharagama, Wattala-Mabole, Peliyagoda, Seethawaka and Hatton-Dickoya) and 29 Pradesheeya Sabas.

The Local Authority areas overlap with District Secretary Areas as well (Table 5). Therefore, the selection of local level committees and minor-watershed planning efforts (Chapter 04) need to take into account the presence of both Local Authorities coming under the Provincial

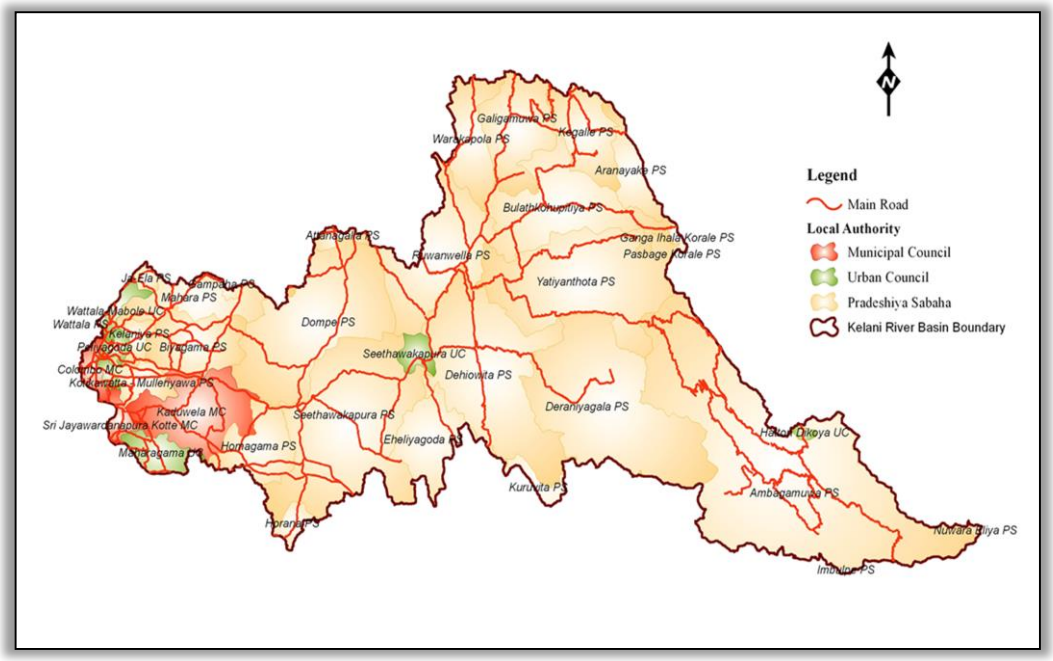

Figure 7: Municipalities, Urban Councils and Pradesheeya Sabhas
Source: R&D unit of CEA

Administration and District Secretary Areas coming under District Administration. Local Authorities play a key role in service delivery and issuing permits for Small and Medium industries. At the same time District Secretaries also play a key role in development work within the basin in many ways. The water discharges from municipalities and urban areas poses special challenges due to concentrated human activity in MC and UC areas. Sources of pollution may include industry, businesses, municipal wastewater, storm water, spills, septic systems and many other sources. In addition, the urban populations next to the river add pollution from households, ranging from cleaners to paints, from motor oil to fertilizers. These pollutants cause many problems by contamination of fish-growing areas; water unsafe to swim in; and toxic substances entering the food chain etc. Clean-ups are expensive to business and taxpayers and polluted areas often cannot be used for development, industry or recreation, therefore awareness, education and pollution prevention are key areas for urban related pollution control efforts.

Table 5: Municipalities, Urban Councils and Pradesheeya Sabhas

District Name	DSD Name	Local Authority Name	Area (km^2)
Colombo	Colombo	Colombo MC	12
Colombo	Homagama	Homagama PS	50
Colombo	Kaduwela	Kaduwela MC	86
Colombo	Kolonnawa	Kolonnawa UC	5
Colombo	Kolonnawa	Kotikawatte - Mulleriyawa PS	22
Colombo	Maharagama	Maharagama UC	24
Colombo	Padukka	Seethawaka PS	218
Colombo	Padukka	Seethawaka UC	13
Colombo	Sri Jayawardanapura Kotte	Sri Jayawardanapura Kotte MC	12
Gampaha	Attanagalla	Attanagalla PS	10
Gampaha	Biyagama	Biyagama PS	61
Gampaha	Dompe	Dompe PS	173
Gampaha	Gampaha	Gampaha PS	5
Gampaha	Ja-Ela	Ja-Ela PS	6
Gampaha	Kelaniya	Kelaniya PS	13
Gampaha	Kelaniya	Peliyagoda UC	8
Gampaha	Mahara	Mahara PS	48
Gampaha	Wattala	Wattala PS	2
Gampaha	Wattala	Wattala - Mabola UC	11
Kalutara	Horana	Horana PS	12
Kandy	Ganga Ihala Korale	Ganga Ihala Korale PS	3
Kandy	Pasbage Korale	Pasbage Korale PS	1
Nuwara Eliya	Ambagamuwa	Ambagamuwa PS	423
Nuwara Eliya	Ambagamuwa	Hatton - Dickoya UC	4
Nuwara Eliya	Nuwara Eliya	Nuwara Eliya PS	3
Kegalle	Aranayaka	Aranayaka PS	34
Kegalle	Bulathkohupitiya	Bulathkohupitiya PS	127
Kegalle	Dehiovita	Dehiovita PS	190
Kegalle	Deraniyagala	Deraniyagala PS	218
Kegalle	Galigamuwa	Galigamuwa PS	75
Kegalle	Kegalle	Kegalle PS	55
Kegalle	Ruwanwella	Ruwanwella PS	104
Kegalle	Warakapola	Warakapola PS	51
Kegalle	Yatiyanthota	Yatiyanthota PS	185
Ratnapura	Eheliyagoda	Eheliyagoda PS	55
Ratnapura	Imbulpe	Imbulpe PS	2
Ratnapura	Kuruwita	Kuruwita PS	12
		Total Area	2,333

Source: R&D unit of CEA

2.7. Local Authority and Divisional Secretary areas within sub-watersheds

The basin area consists of 37 local authorities and 36 Divisional Secretariat divisions. Some of them are completely within the watershed and some are partially. Therefore, during the KRMP approach to establish the management units both local authority and divisional secretariat divisions within sub- and minor-watersheds are to be considered along with communities, private sector and schools within those watershed boundaries.

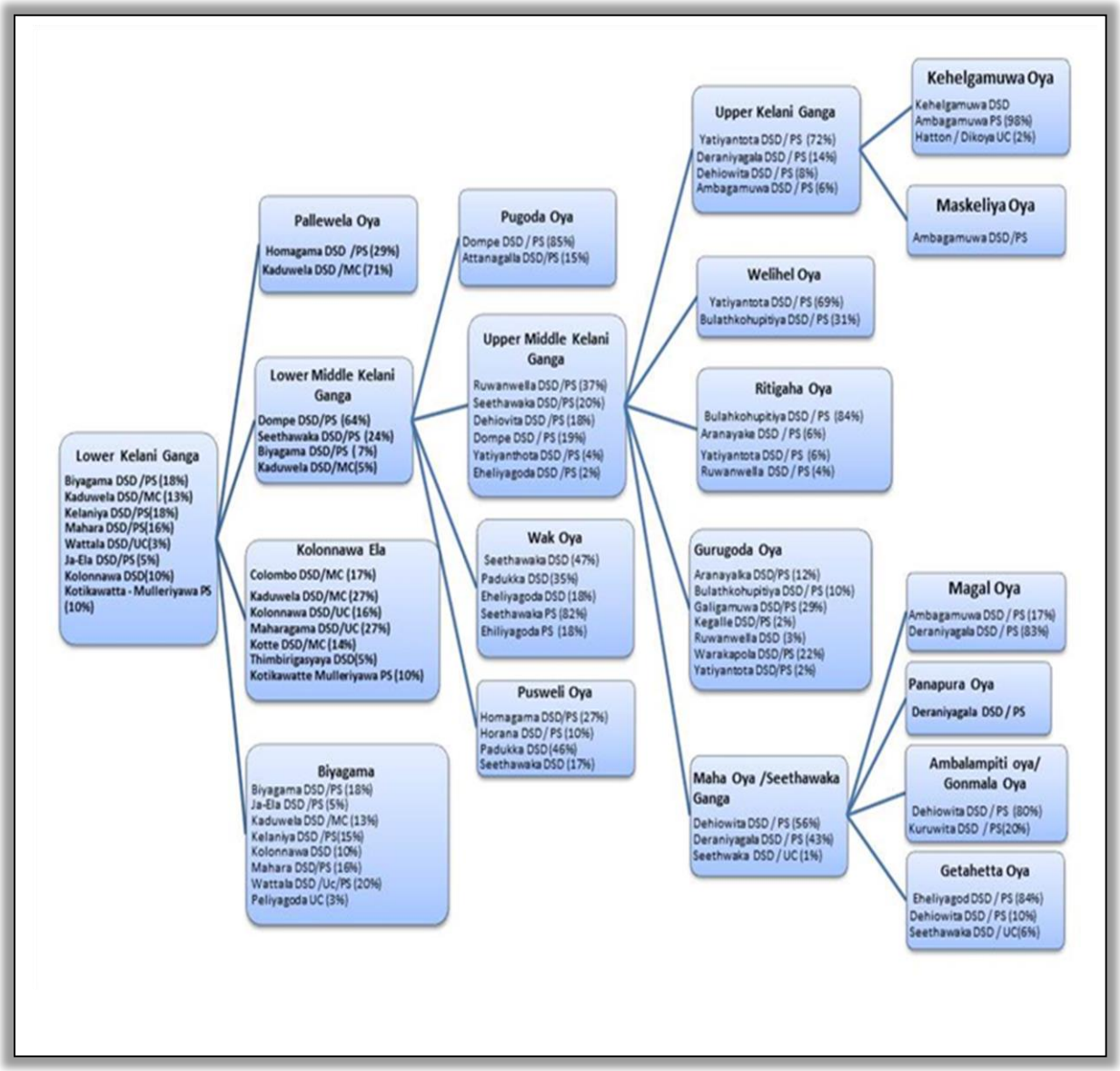

Figure 8: Local Authority and DS Divisions in 20 sub-watersheds

2.8. Population and housing

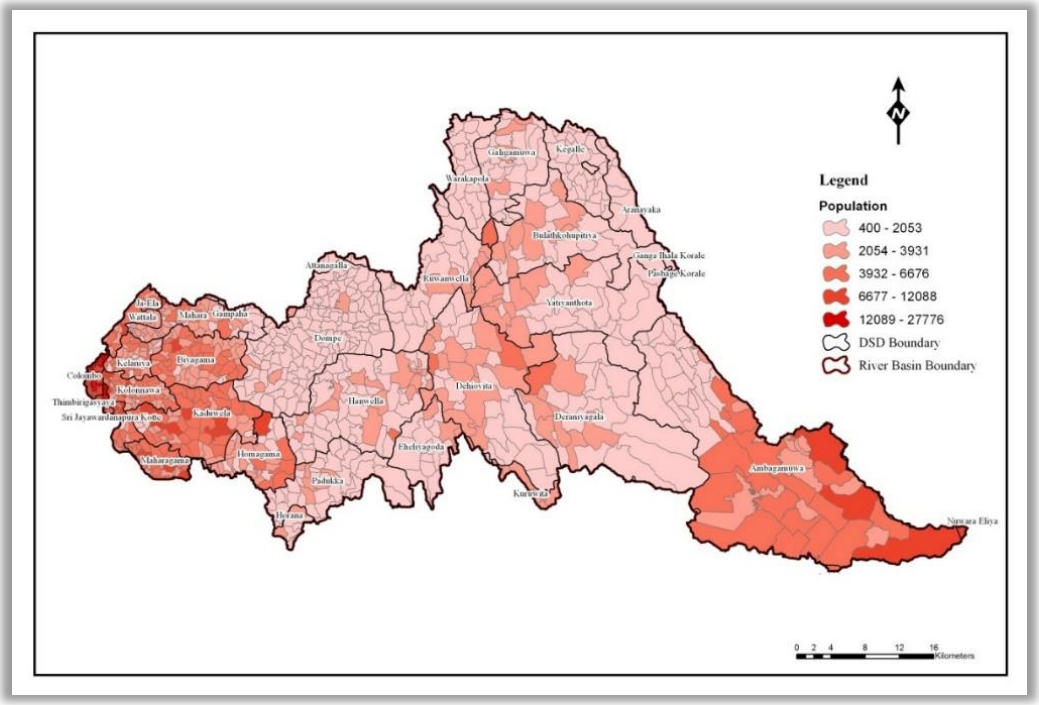

Figure 9: Population density per sq. km.
Source: R & D unit of CEA based on Dept. of Census and Statistics data

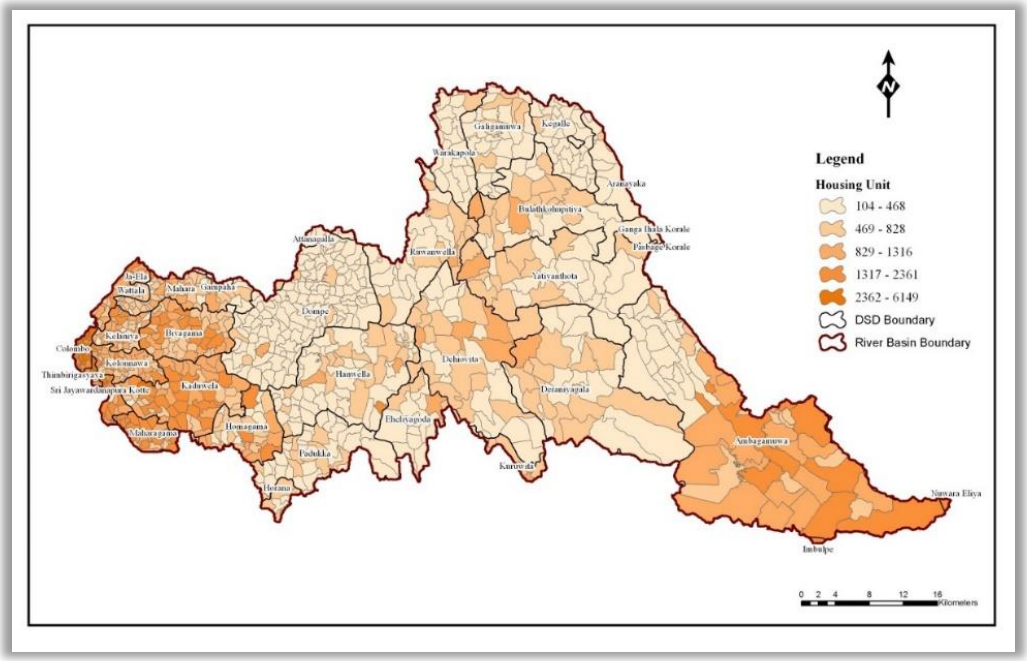

Figure 10: Houses per square kilo meter
Source: R & D unit of CEA based on Dept. of Census and Statistics data

Population and housing density increases towards downstream direction, except the plantation areas in the upper reaches where working population resides. Along with high population density the provision of service delivery including waste and sewerage management are significant.

2.9. Roads and streams

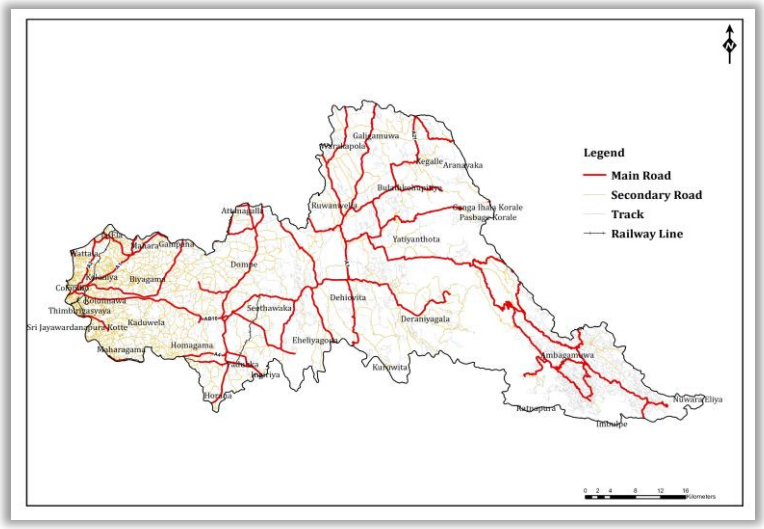

Figure 11: Road network in the Kelani River Basin
Source: Survey Department

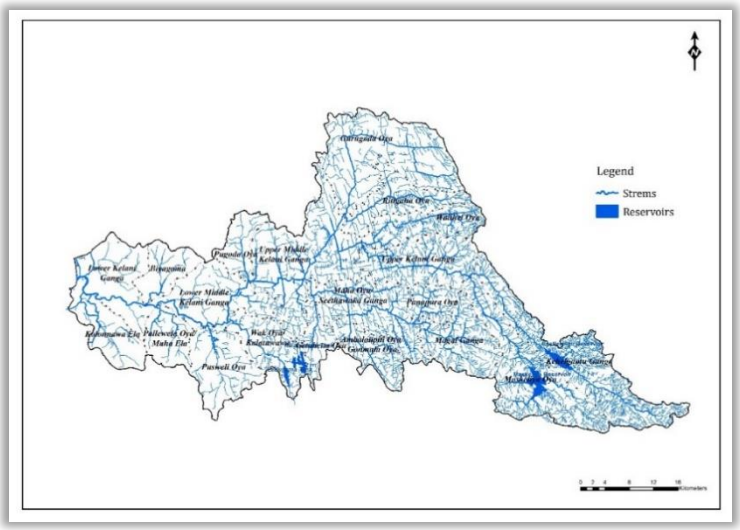

Figure 12: Stream network with reservoirs
Source: Survey Department

Roads, related infrastruure and drainage are closely linked to water quality, quantity and developoment issues such as soil erosion, altered hydrology and flooding, deforestation, damage to valuable ecosystems and habitats, damage to scenic quality and tourism and human health and safety. For example, the open road cuts (new or old constructions) has the potential to release sediments during intense rain events. In addion oil, greese and other petrolium based chemicals can get washed into streams along with storm water.

At the same time the stream banks also get affected by rainfall and add sediments into the system. These factors highlights the improtance of managing road cuts and stream banks related erosion potential and paying more attention on the periods of construction (eg: addition care in developing or reparing roads prior to rainy seasons).

2.10. Existing and proposed Forest Reservations

There are a number of important forest reservations in the Kelani River Basin. The Forest Department is in the process of expanding the forest reservations. Forests in steep areas are highly prone to soil erosion and land degradation unless proper land use management practices are employed. In addition, in some of the forest areas have cultivations that are not optimal for the land characteristics – for example the pine plantations. Lands ownership in sensitive areas with high eroding potential are managed by Forest Department but owned by the Land Reform Commission that may not be the optimal management for better land management towards pollution prevention.

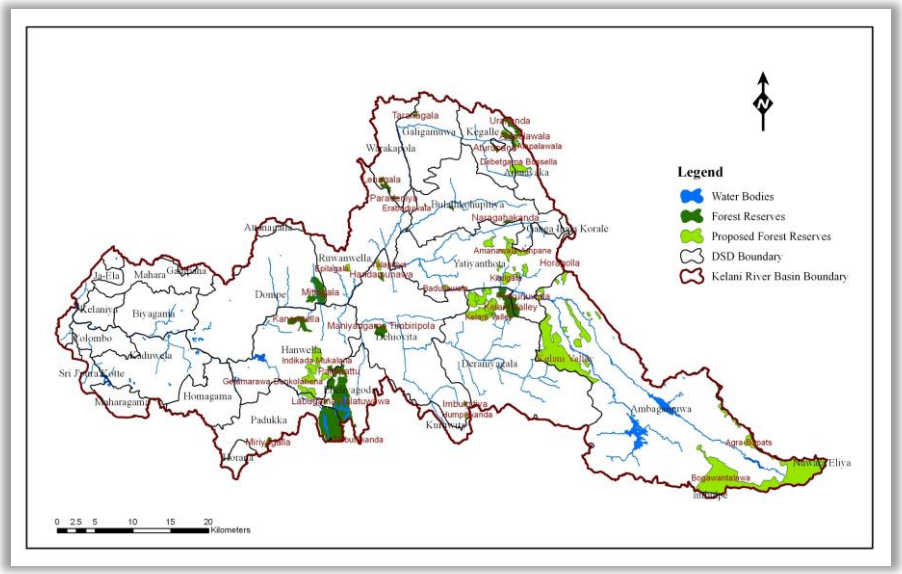

Figure 13: Existing and proposed forest reservations
Source: R & D Unit of CEA based on Forest Department data

Table 6: Existing forest reserves

	Name	Area (km^2)
1	Aturupana	0.48
2	Eluwana	1.51
3	Imbulpitiya	0.19
4	Handamunawa	0.48
5	Horagolla	0.28
6	Kananpella	2.98
7	Kelani Valley	6.25
8	Labugama Kalatuwawa	20.33
9	Lenagala	1.38
10	Lewala	0.27
11	Maniyangama Timbiripola	2.12
12	Miriyagalla	0.62
13	Mitirigala	5.00
14	Pallepattu	4.32
15	Paradeniya	0.31
16	Tarangala	0.39
17	Naragahakanda	0.34
18	Pokunuwala	0.09
19	Radawela	0.09
20	Urakanda	1.21
	Total	48.64

Table 7: Proposed forest conservations

	Name	Area (km^2)
1	Agra-Bopats	5.6
2	Alapalawala	1.92
3	Amanawala - Ampane	4.71
4	Badullawala	0.53
5	Bogawantalawa	35.46
6	Debatgama Bossella	2.15
7	Epilagama	0.52
8	Erabaduwala	0.06
9	Getamarawa-Dunkolahena	0.87
10	Humpitikanda	0.29
11	Indikada Mukalana	7.69
12	Kelani Valley	36.59
13	Kithulgala	4.61
14	Tibbotukanda	0.34
15	Yalapitiya	0.59
	Total	101.93

2.11. Wildlife areas

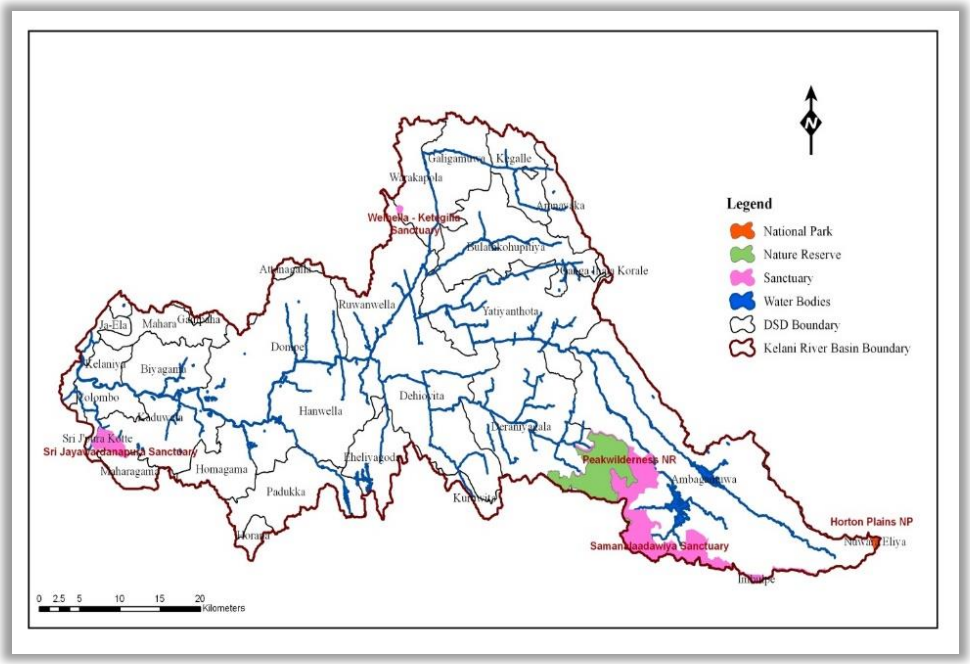

Figure 14: Wildlife areas in Kelani River Basin
Source: R & D unit of CEA based on Department of Wildlife Conservation data

Table 8: Wildlife areas within the Kelani River Basin

Type	Name	Area (km^2)
Sanctuary	Welhella-Katagilla	0.59
Sanctuary	Sri Jayawardhenapura	7.99
Sanctuary	Samanalaadawiya	58.05
National Park	Horton Plains	1.15
National Park	Peakwilderness	41.67
Total		**109.45**

There are three Sanctuaries and two national parks within the Kelani River Basin, managed by the Department of Wildlife Conservation. These areas can be productively used for environment education and awareness and economic activities such as ecotourism.

2.12. Sensitive areas

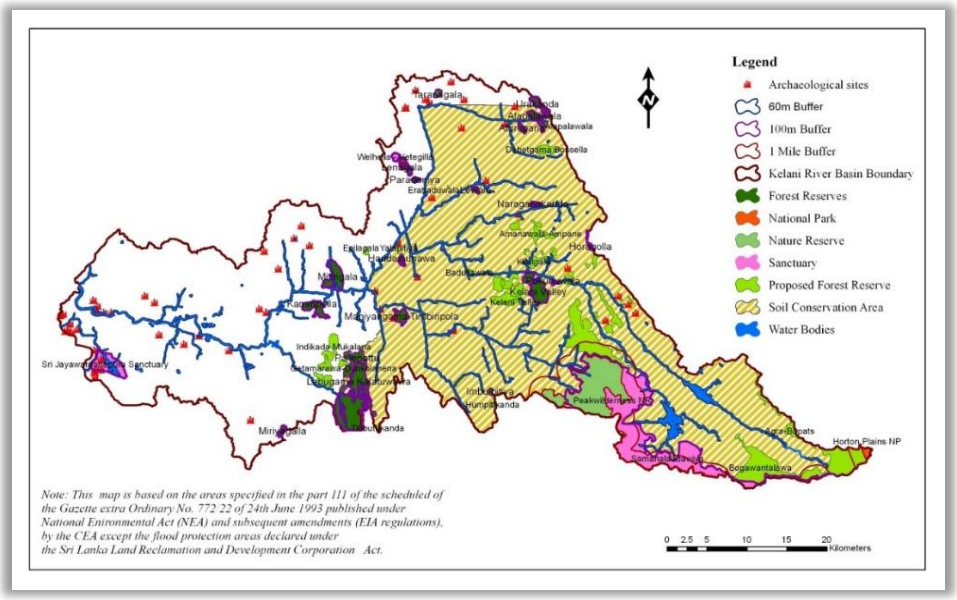

Figure 15: Environmentally sensitive areas
Source: R&D Unit of CEA based on FD, AD, DWC & SD data

2.13. Archaeological sites

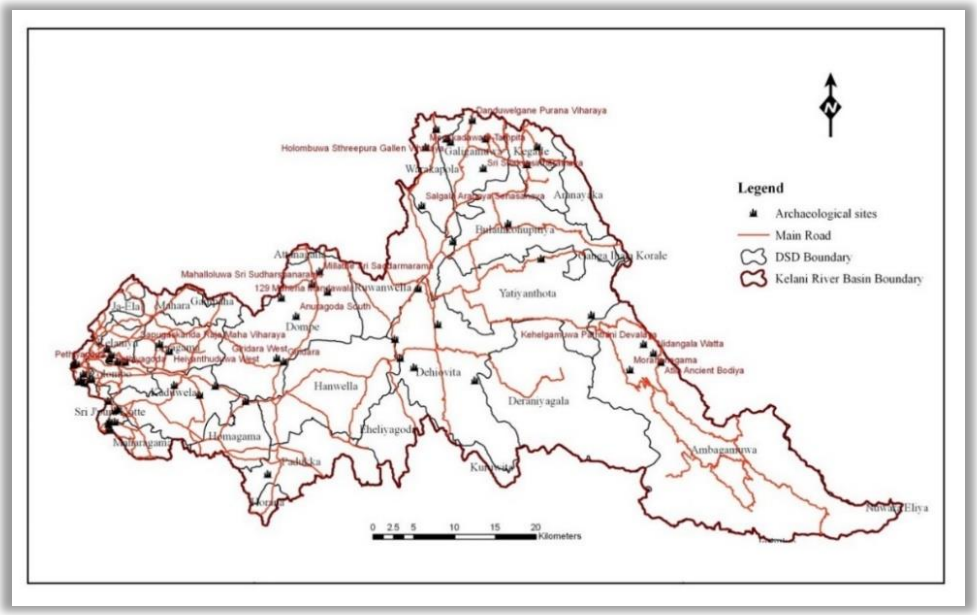

Figure 16: Known archaeological sites within the Kelani River Basin
Source: R&D Unit of CEA based on Archaeological Department data

2.14. Biodiversity

Biodiversity in the Kelani River Basin is an asset that can be used not only in the form of conservation but also to promote green business as an alternative to the livelihoods that are damaging to the river basin ecosystem such as industry, sand mining etc. There are a number of proposals in the Action Plan (Chapter 05) proposing such alternatives.

Kelani basin lies within three major floristic regions, namely Northern Wet lowlands, Foothills of Adam's Peak and Ambagamuwa**,** Adam's Peak. These floristic regions sustain three major vegetation types such as Tropical wet evergreen forests, Tropical montane forests and Tropical submontane evergreen forests (Jayasuriya, Kitchener & Biradar, 2006).

2.14.1 Tropical Wet Evergreen Forests (TWEF)

TWEF is the widespread matrix vegetation in the low to mid basin sector of the Kelani basin occurring in the wet lowlands up to an elevation of 900 m. TWEF is markedly stratified and characterized by a tall and dense canopy structure that reaches about 30 m in height with emergent reaching 45 m or more above the canopy line with their characteristic cauliflower or mushroom-like crowns. A broad sub-canopy of 15-30 m and a sparse shrub layer, which consists mostly of tree saplings, and a scanty herbaceous ground flora complete the forest profile. Lianas are an essential component while epiphytes, mainly composed of ferns, orchids, lichens, fungi and bryophytes, are also abundant in the TWEF. Numerous epiphyllous mosses and liverworts add diversity to its plant life forms.

2.14.2. Tropical Submontane Evergreen Forests (TSEF)

This is essentially a transitional vegetation type between TWEF and Tropical Montane Evergreen Forest (TMEF) found in the Kelani basin, occurring between 900-1400 m in the third Peneplains of the island. The nature of the structure and physiognomy of the TSEF is intermediate between the TWEF and TMEF. The forest profile is less distinctly stratified compared to that of TWEF. The canopy reaches generally 15-20 m in height without emergents, although in dipterocarp-dominated stands some *Doona* species emerge up to about 30 m. The sub-canopy and the shrub layers are less distinct; nevertheless, they can be recognized in undisturbed sites.

2.14.3. Tropical Montane Evergreen Forests (TMEF)

The TMEF occurs above 1500 m in the central highlands in the upper Kelani basin. Thus cool and wet conditions that prevail here along with abundant mist, relatively strong winds and elevated solar radiation determine the nature and form of the plant life in TMEF. These forests are characterized by a relatively low canopy between 8 and 10 m in typical stands at higher altitudes, and they may grow higher to about 15m or even 20 m on leeward slopes or at lower altitudes within the range. The trunks and branches of the trees that make up the canopy are twisted and gnarled and their crowns are flat-topped; the leaves are microphyllous and leathery to withstand strong winds. The forest profile is not clearly stratified, but the lower strata consisting of tree and shrub species are very dense. The trees and shrubs are covered with epiphytes, lichens and bryophytes, while the leaves harbour many epiphyllous mosses and liverworts indicating copious moisture condensation.

2.14.4. Point Endemics and restricted species

A detailed biodiversity survey has not been conducted throughout the Kelani River Basin. However, there are few random surveys carried out by researchers to fulfill various objectives and these data was used to construct the biodiversity profile of the Kelani River Basin.

Therefore, it should be noted that the information presented below is based on a limited data set and that the actual biodiversity of Kelani River Basin could be much higher than what is presented here with more information.

According to previous surveys a number of point endemic, endemic and threatened fauna and flora are present within the Kelani Basin. A single point endemic plant species, *Balanocarpus kitulgalensis* is recorded in the Kelani river basin. *B. kitulgalensis* was described from the Parawalatenna forest reserve (on the opposite bank of the Kitulgala rest house) and it is only known from this site with limited number of individuals.

Another plant species, *Vetica luwesiana* that was earlier recorded from Kiribatgala and Hunuwela in the Kalu river basin but no longer found in this site since 1880s was recently (in 2008) discovered from the Halgolla estate by IUCN near We Oya, a tributary of the Kelani river. At present this plant is known from less than 10 trees.

Several point endemic fauna are also found in the Kelani river basin. This includes *Pethia bandula* that is restricted to a small stream that drains into Gurugoda Oya, a tributary of Kelani River. The population size of this fish is less than 1500. *Systomus asoka* is another point endemic fish restricted to the Kelani basin. It can be found in the main river closer to Kitulgala and Malimboda area in the Sitawaka tributary. In addition, several other invertebrate point endemic species are recorded in the Kelani River basin. These include a damselfly species *Archibasis oscillans* (found in the Hanwella area) and three species of freshwater crabs, *Perbrinckia cracens*, *Ceylonthelphusa nata* and *Clinothelphusa kakoota*. All of these species are listed as a Critically Endangered (CR) species in the National Red list (except *Archibasis oscillans* as it is a new discovery for Sri Lanka) due to their limited distribution.

2.14.5. Threatened species found in the Kelani River Basin

The statistics of threatened species in the Kelani River Basin are included in detail in the Natural Resource Profile of the Kelani River Basin (Goonatilake, et. al., 2016)

Dragonflies – Total of 16 nationally threatened species were recorded within the Kelani valley basin. Among them eight species are listed as critically endangered (CR) seven species as endangered (EN) and one species as vulnerable (VU).

Butterflies - Altogether 23 nationally threatened species of butterflies are recorded within the Kelani river basin. This includes one critically endangered (CR), 10 endangered (EN) and 12 vulnerable (VU) species.

Freshwater fish – Altogether 27 nationally threatened species are recorded within the Kelani River Basin. This included eight critically endangered (CR), 15 endangered (EN) and four vulnerable (VU) species.

Amphibians – Total of nine nationally threatened species are recorded within the Kelani valley basin. This includes six endangered and three vulnerable species.

Reptiles – Total of 11 nationally threatened species are recorded within the Kelani valley basin. This includes one critically endangered (CR) six endangered (EN) and five vulnerable (VU) species.

Birds- Total of 25 nationally threatened species are recorded within the Kelani valley basin. This includes 10 endangered (EN) and 15 vulnerable (VU) species.

Mammals- Area total of 28 nationally threatened species are recorded within the Kelani valley basin. This includes one critically endangered (CR) 14 endangered (EN) and 13 vulnerable (VU) species.

2.15. Landslides and floods

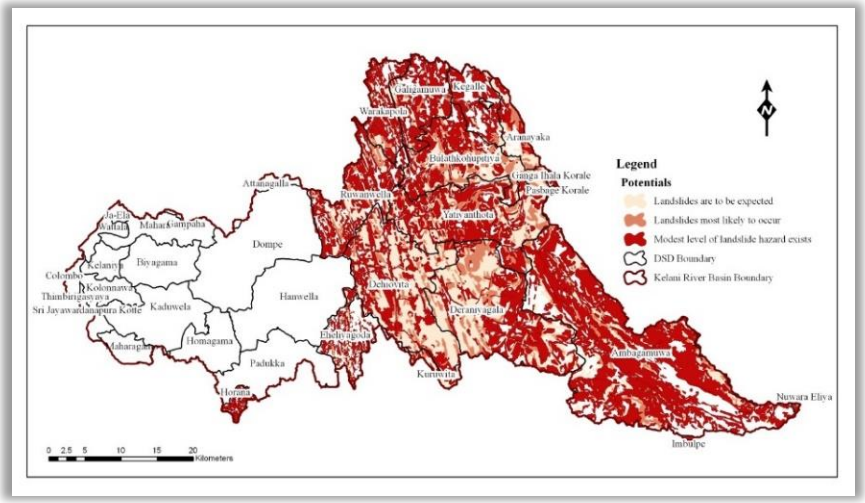

Figure 17: Areas with landslide potential
Source: R&D Unit of CEA based on NBRO data

About 400 sq. km. are under high landslide prone areas where landslides can be expected anytime. About 140 sq. km. are under most likely areas and about 650 sq. km. area are under modest likelihood of having a landslide according to the Landslide Studies Division of the National Building Research Organization (NBRO). Similarly, the National Hazard Profile for Floods (DMC, 2012) highlights areas under flooding threat within the Kelani River Basin.

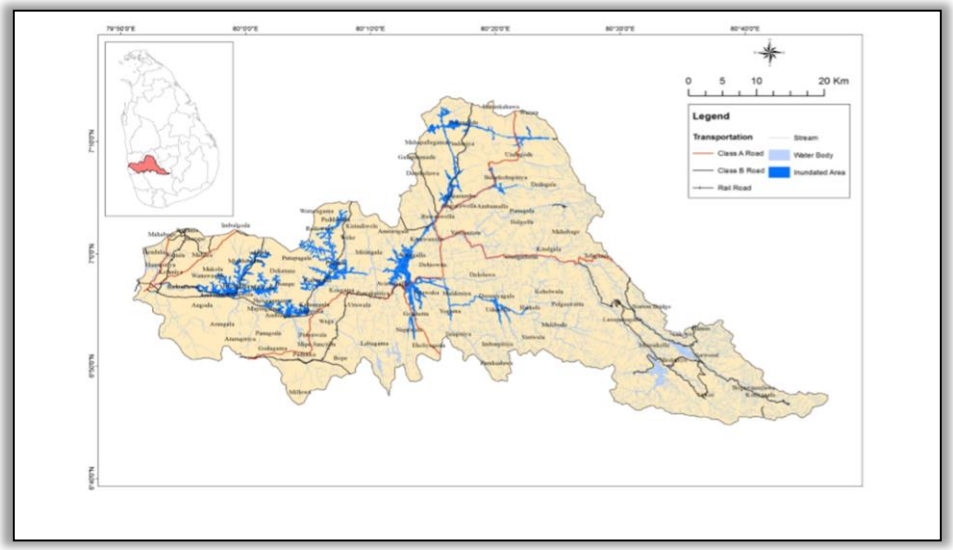

Figure 18: Flood inundation areas
Source: Disaster Management Centre (2012)

Table 9: Soil types in the Kelani River Basin

	Soil Extent (ha)										
Sub Catchment/soil type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Ambalanpiti Oya/Gonmala Oya							90	6,875			
Biyagama	192					5,982	1,103				
Getahetta Oya							3,184	3,008			
Gurugoda Oya				1,880				14,150	4,674		
Kehelgamu Ganga				4,841	305			15,946			133
Kolonnawa Ela	434	2,334				5,814				15	
Lower Kelani Ganga	2,797	350	419			8,374				238	
Lower Middle Kelani Ganga	2,048					10,043		688			
Magal Ganga				5,552				4,605			966
Maha Oya/Seethawaka Ganga							1,515	12,985			
Maskeliya Oya				11,237				6,045			2,255
Pallewela Oya/Maha Ela	208	166				4,964		807			
Panapura Oya								4,289			
Pugoda Oya	35					5,104		75			
Pusweli Oya	28	493				6,059		4,787			228
Ritigaha Oya				2,422			932	5,813			157
Upper Kelani Ganga				3,548			76	9,577			
Upper Middle Kelani Ganga	234					3,957	4,455	15,332			
Wak Oya/Kalatuwawa	143	216				1,973		6,649			
Walihel Oya				5,012			224	3,339			347

2.16. Soil types

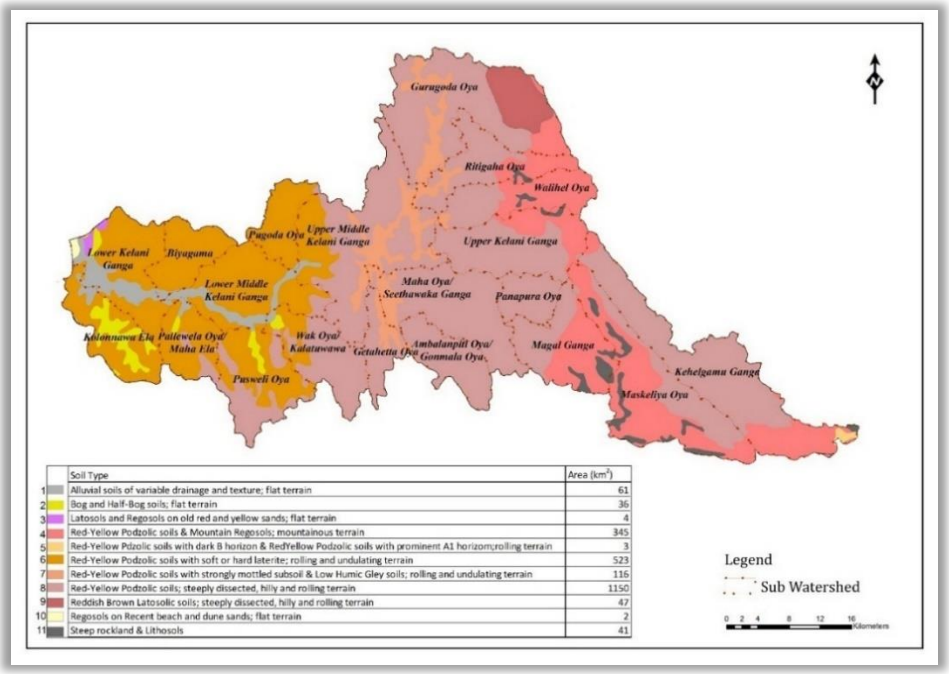

Figure 19: Soil types in the Kelani River Basin
Source**:** Survey Department (2007)

2.17. Climate and agro ecological zones

2.17.1. Rainfall:

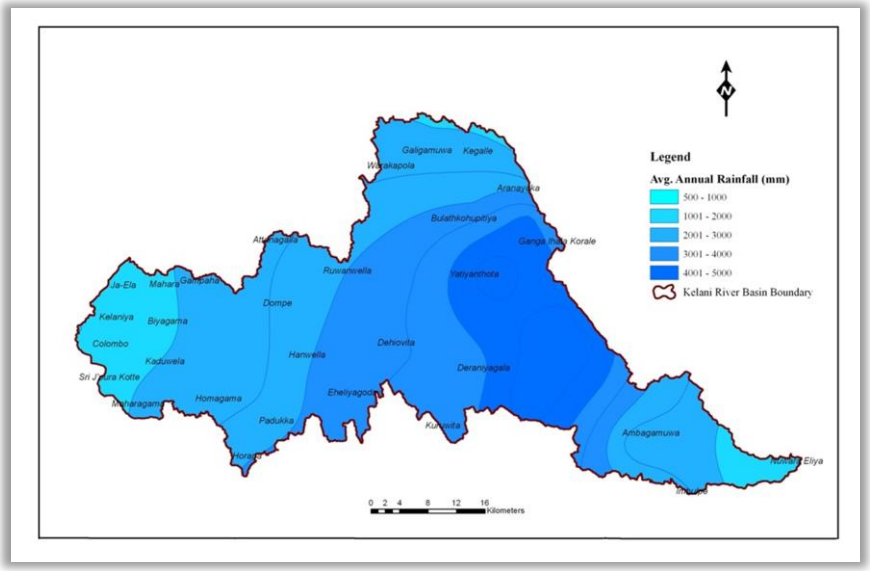

Figure 20: Rainfall distribution
Source: R&D unit CEA based on Met. Dept. data

The annual rainfall distribution varies from 500 mm to 5,000 mm with an average mean annual rainfall about 3,450 millimetres. The watersheds in the middle of the Kelani River Basin receive the highest rainfall. As indicated in the introduction the total volume of water falling within the basin is estimated at 7,865 Million Cubic Meters (MCM) with about 43% of rainfall ending in Indian Ocean.

2.17.2. Agro-ecological regions

The Kelani River passes through the Up Country Wet Zone (WU), Mid-Country Wet Zone (WM) and Low Country Wet Zone (WL). Within these zones the basin is divided into a number of agro-ecological regions starting from hills towards the coastal area WU_3, WU_2, WU_1, WM_1, WL_1, WL_2 and WL_3 (Panabokke, 1996). Later the same regions were further subdivided into 10 agro-ecological regions. Climatic conditions for agro-ecological regions within the Kelani River basin demonstrates variations in mean temperature and annual rainfall while the humidity level remains almost same (Punyawardena, 2004).

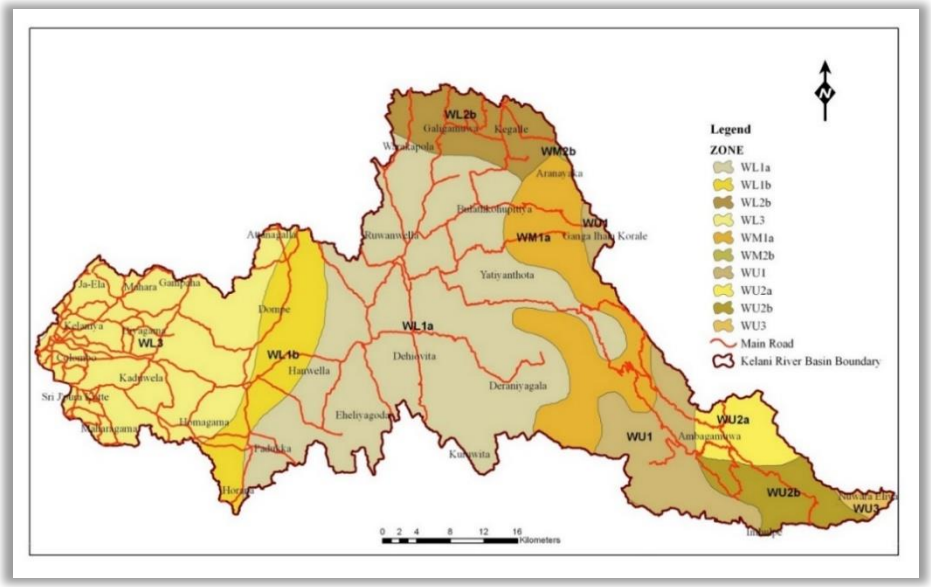

Figure 21: Agro ecological regions within the Kelani River Basin
Source: R & D Unit of CEA based on Agriculture Department data

Table 10: Climate conditions in agro-ecological zones

Agro-ecological region (AER)	Mean Temperature	75% Expectancy of Annual Rainfall (Panabokke, 1996)	Day time relative Humidity
WU_3	13-16^{0}C	> 3,175 mm	-
WU_2	13-16^{0}C	> 1,900 mm	-
WU_1	13-16^{0}C	> 1,400 mm	-
WM_1	23-28^{0}C	> 3,150 mm	55-80%
WL_1	27^{0}C	> 2,525 mm	60-75%
WL_2	28^{0}C	> 1,900 mm	60-75%
WL_3	-	> 1,525 mm	60-75%
WL_4	29^{0}C	> 1525 mm	60-75%

2.18. Slope Steepness

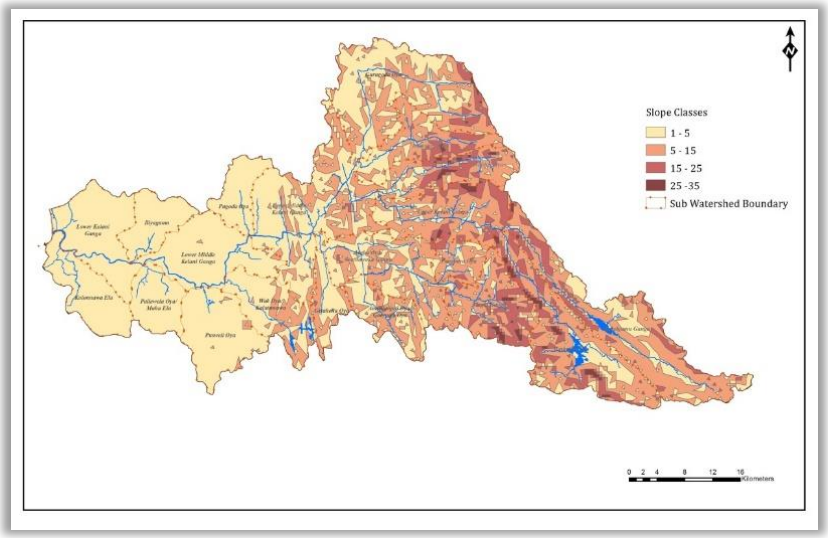

Figure 22: Slope Steepness Classes
Source: IUCN based on Survey Department contour data

2.19. Land use pattern

Table 11: Slope steepness classes by sub-basin

Sub Catchment	Slope Extent (ha)			
	Low (0-5)	Moderate (5 - 15)	High (15-25)	Very High (25-35)
Ambalanpiti Oya/Gonmala Oya	3,471	3,427	67	
Biyagama	6,173	1		
Getahetta Oya	2,710	1,589	29	
Gurugoda Oya	13,158	9,428	1,212	80
Kehelgamu Ganga	5,436	12,680	3,028	67
Kolonnawa Ela	8,581			
Lower Kelani Ganga	11,765			
Lower Middle Kelani Ganga	12,631	148		
Magal Ganga	1,283	6,260	3,203	377
Maha Oya/Seethawaka Ganga	7,102	7,250	148	
Maskeliya Oya	4,220	10,732	3,857	728
Pallewela Oya/Maha Ela	6,146			
Panapura Oya	1,027	2,918	344	
Pugoda Oya	5,214			
Pusweli Oya	11,102	265		
Ritigaha Oya	2,805	5,160	1,369	60
Upper Kelani Ganga	2,527	7,865	2,684	283
Upper Middle Kelani Ganga	15,985	7,908	84	
Wak Oya/Kalatuwawa	6,463	2,898	11	
Walihel Oya	1,964	4,727	1,929	303
Total	129,762	83,256	17,965	1,898
%	55.7	35.8	7.7	0.8

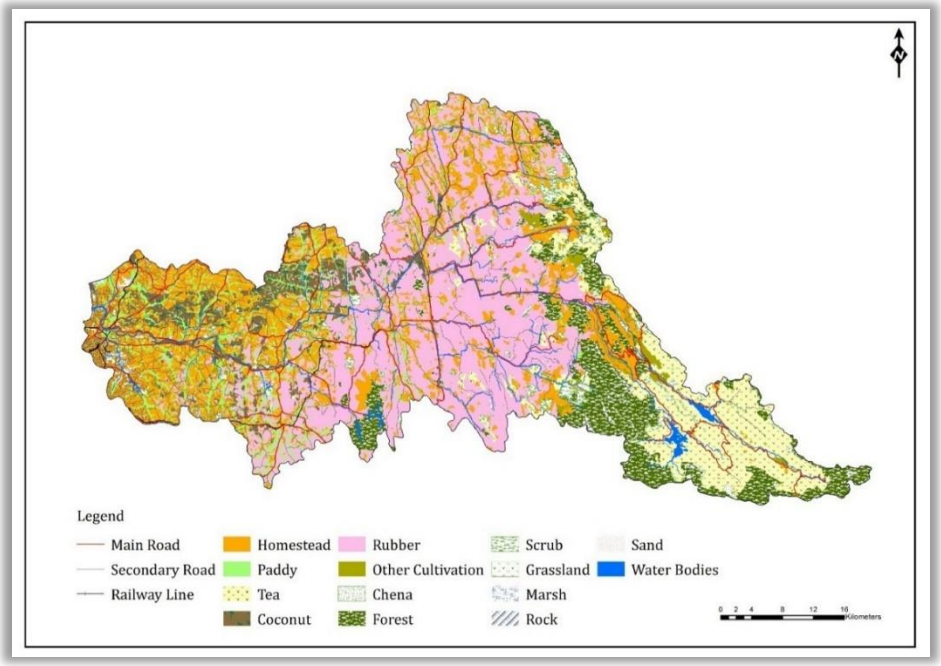

Figure 23: Land use pattern in the Kelani River Basin
Source: R&D unit of CEA based on Survey Dept. data

The largest land use categories are Forest, Home Gardens, Rubber and Tea. However, this land use classification is not done at a high resolution and ground trothing is not used. Therefore, it is not advisable to use this for decision making other than the general use. For example, the area under rubber seems excessive.

The World Bank is supporting the Survey Department to develop an accurate land use map of Kelani basin in collaboration with European Space Agency using the satellite imagery for 1991, 2001 and 2012. Survey Department is also starting a LiDAR survey for the western province under JICA support and there will be a Digital Elevation Model with very high accuracy. SLLRDC has a LIDAR data set for the Metro Colombo area.

Table 12: Land use pattern in Kelani River Basin

Land use Category	Area km2	%
Chena	16	0.7
Coconut	70	3.0
Forest	237	10.2
Grassland	2	0.1
Home Gardens	647	27.9
Marsh	24	1.0
Non-agricultural land	4	0.2
Other Cultivation	39	1.7
Paddy	150	6.5
Rock	19	0.8
Rubber	695	30.0
Scrub	68	2.9
Tea	300	12.9
Water Bodies	48	2.1
	2,319	100.0

2.20. Industries

Industries with pollution potential or high polluting are categorized by the Central Environment Authority (CEA) into three broad groups namely Type A, Type B and Type C depending on the severity of pollution potential and to guide the sitting of those industries.

Table 13: Industry types and distribution in sub-basins

Sub Catchment	A	B	C	Total	%
Ambalanpiti Oya/Gonmala Oya	6	9	9	24	0.8
Biyagama	14	58	1	73	2.6
Getahetta Oya	10	14	31	55	1.9
Gurugoda Oya	34	62	118	214	7.5
Kolonnawa Ela	180	296	47	523	18.4
Lower Kelani Ganga	190	183	66	439	15.4
Lower Middle Kelani Ganga	50	43	30	123	4.3
Magal Ganga	0	0	2	2	0.1
Maha Oya/Seethawaka Ganga	18	34	50	102	3.6
Pallewela Oya/Maha Ela	161	230	67	458	16.1
Panapura Oya	0	0	3	3	0.1
Pugoda Oya	7	7	5	19	0.7
Pusweli Oya	148	173	184	505	17.8
Ritigaha Oya	5	27	24	56	2.0
Upper Kelani Ganga	2	8	21	31	1.1
Upper Middle Kelani Ganga	28	61	78	167	5.9
Wak Oya/Kalatuwawa	7	4	12	23	0.8
Walihel Oya	2	11	12	25	0.9
Total	862	1,220	760	2,842	100.0
%	30.3	42.9	26.7	100.0	

Type A: According to the CEA guidelines, type A industries are not permitted to be located upstream of drinking water abstraction points. The Type A industries should be preferably clustered within planned industrial zones. The effluents from Type A industries should not be discharged upstream directly or indirectly (through a tributary or otherwise). The effluents should be treated to the designated national effluent standards prior to discharging in to water bodies (Annexure 2), which are not used as a drinking water source or downstream of the last drinking water abstraction point or to the marine environment.

Type B: They are permitted to be located upstream of drinking water abstraction points, with a safe distance from any downstream intake point. For discharges from Type B high polluting industries CEA guidelines included a) Minimum safe distance of one (1) kilometer shall be maintained for all such discharges; b) The computation of safe distance (Ds) in kilometers shall be, $Ds = Q_d / Q_{min} * 24$ Where Q_d = quantity of discharge of treated effluent Q_{min} = minimum river flow (This formula is based on the consideration that a safe distance of 3 km should be applicable for a dilution factor of 1/8); c) If the computed safe distance (Ds) is less than 1 km, the safe distance will be decided on a case by case basis; d) The total cumulative discharges from Type B industries within a distance of 5 km upstream from a drinking water abstraction point, shall be subject to a maximum of $Q_{min}/8$; e) In addition, there should be a restriction on permitting new industries, if it is found that, with the introduction of such industry, the "relevant standards for water abstracted for drinking water supply" cannot be maintained at the abstraction points.

The effluents from these industries should be treated to the designated national effluent standards prior to discharge.

In the Kelani River Basin (KRB) the Industrial Effluent Discharge of the industries at the Biyagama EPZ is treated by a conventional treatment facility available at

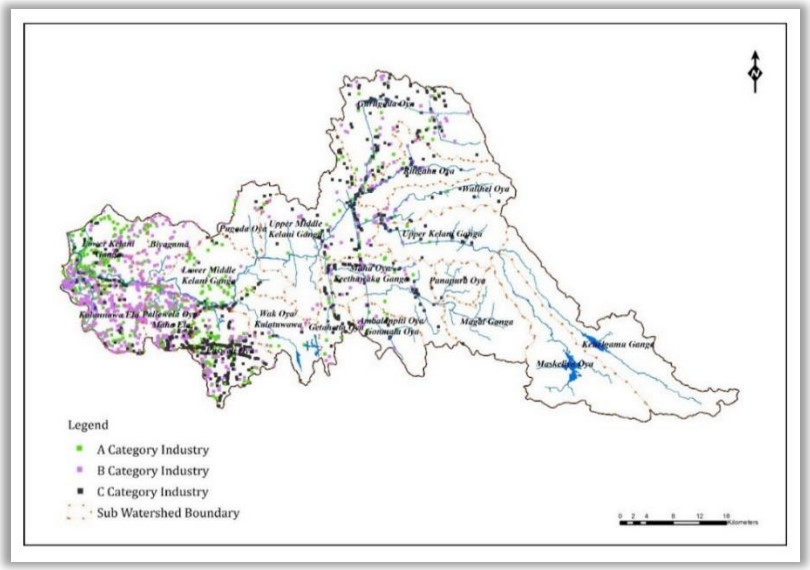

Figure 24: Industry categories and distribution
Source: R&D unit of CEA

site and discharged into Kelani River through Rakgahawatta canal which is located upstream of water intakes of Ambathale and Kelani Right Bank water treatment plants.

During the implementation of the proposed Strategy and Action plan it is proposed to review the current status of each industry including the locations and details of the treatment process available in order to facilitate the industrial environment management. In addition, the project proposes to advance the capacities of operational personnel, in-house testing facilities, record keeping and continuous monitoring of water quality, including monitoring.

2.21. Schools

There are nearly 800 schools within the Kelani River Basin.

Some schools participate in the CEA led Environment Pioneer Programme (EPP) having school level environment activities. During the KRMP approach, a systematic school led awareness and education programme is being proposed to improve the knowledge of the school children but also to engage their parents and communities.

Table 14: Schools in Kelani River Sub-basins

Sub Catchment	No of school
Ambalanpiti Oya/Gonmala Oya	16
Biyagama	25
Getahetta Oya	11
Gurugoda Oya	83
Kehelgamu Ganga	83
Kolonnawa Ela	56
Lower Kelani Ganga	82
Lower Middle Kelani Ganga	48
Magal Ganga	12
Maha Oya/Seethawaka Ganga	47
Maskeliya Oya	47
Pallewela Oya/Maha Ela	24
Panapura Oya	12
Pugoda Oya	12
Pusweli Oya	41
Ritigaha Oya	20
Upper Kelani Ganga	31
Upper Middle Kelani Ganga	71
Wak Oya/Kalatuwawa	18
Walihel Oya	20
Total	759

Chapter 03: Regulatory and Institutional Systems

3.1. Land use for water source protection

Water is one of the main natural resources in Sri Lanka and it is one of the main inputs to the country`s economic development since ancient times. The recent "National Policy on Protection and Conservation of Water Sources, their Catchments and Reservations" led by the Ministry of Land and Land Development Sri Lanka, 2014 (Gazette no.1894/3 22/12/14) is one of the key policies that was introduced with a vision "Water Resource for the Future Generation."

The goal was to ensure the protection and conservation of all the water sources and their source areas in Sri Lanka through land management. The Land Use Policy Planning Department (LUPPD) of the Ministry of Land and Land Development functions as the coordinating institute with an Operational Committee comprising key institutions with a defined Terms of Reference (box).

Terms of Reference of the Operational Committee (adopted from the gazette)

- Identify water sources (springs and rivers, reserves of streams and the reserves of the reservoirs) and demarcate in maps.
- Develop a data base, based on such data and share among institutions concerned.
- Identify and declare water sources and reservations of the rivers and streams to be protected and conserved.
- Take action to evacuate the present encroachments and uses of the reserves through legal means including drafting new laws and a new National Policy on related protection and conservation.
- Prepare land use plans for all water sources, spouts and reserves of the rivers and springs and their source areas.
- Prepare and implement media programmes, curricular development, awareness and educational programmes on conservation of water sources.

3.2. Laws to control pollution potential

The National Environmental Act (NEA) No. 47 of 1980 and its amendments of 1998, 2000 and 2005 are a set of umbrella legislations that are being administered by the Central Environmental Authority (CEA). The NEA uses three primary approaches, namely, i) Environmental protection; ii) Environmental quality; and iii) Environmental assessment and the approval of projects. Two of the tools employed in the NEA, are the Environment Protection Licences (EPL) and Environment Impact Assessment (EIA) processes.

Environmental Protection Licences (EPL)*:* Part IV of the NEA include Environmental Protection Licences (EPL) and the goal of EPLs are to ensure that the discharge, deposit or emission of waste by industrial, commercial or other undertakings are done according to prescribed standards and procedures including the management of *Scheduled waste (hazardous waste) management*. These prescribed activities may be carried out only under permit from the CEA or local authority in accordance with the standards laid down in the NEA. Although standards are prescribed in the Act, the CEA has the authority to impose more stringent standards including the following and the proposed standards.

a. Tolerance limits for the discharge of industrial waste into inland surface waters (Annex 2).
b. Tolerance limits for industrial waste discharged on land for irrigation purpose and hydraulic loading applicable for different soils (Annex 3 and 4).
c. Tolerance limits for rubber waste discharged into inland surface waters (Annex 5).
d. Tolerance limits for waste from textiles industries into inland surface waters (Annex 6).

e. Tolerance limits for waste being discharged from tanning industries (Annex 7).
f. Tolerance limits for effluent discharges to public sewers with central treatment (Annex 8).
g. Tolerance limits for industrial and domestic waste discharged into marine coastal areas (Annex 9).

Environmental Impact Assessment (EIA) or a lower level version of Initial Environmental Examination (IEE) is required for every project referred to as prescribed projects. Part IV C of the National Environmental Act requires the approval process of projects to submit two types of reports: Initial Environmental Examination (IEE) report and Environmental Impact Assessment (EIA) report as per the section 23 Z of the act in the *Gazette Extra Ordinary No. 772/22 dated 24th June 1993*.

The EIA process is implemented through designated Project Approving Agencies (PAAs) specified under Section 23 Y of the NEA. At present, 22 state agencies have been specified as PAAs. Once an EIA report is submitted, the NEA provides for a public inspection and comment on the report during a mandatory period of 30 days. For example, in coastal areas, the PAA is the Coast Conservation and Coastal Resource Management Department. A public hearing may be held to provide an opportunity to any member of the public (who has submitted his/her comments) to be heard in support of the comments if the project approving agency (PAA) considers it to be in the public interest to do so. A decision whether to approve the project has to be arrived at thereafter. The National Environmental Act stipulates that all 'prescribed projects' must receive approval from the appropriate project approving agencies (PAAs).

With respect to non-hazardous, municipal solid waste, the CEA requires local authorities to obtain site clearance for municipal solid waste facilities including landfills. A facility that receives over 100 tons/day needs EIA approval while one that receives less than 100 tons/day needs an environmental recommendation from the CEA.

Furthermore, following solid waste disposal facilities require , an Environmental Protection License (EPL).

a. Municipal solid waste and other solid waste composting plants having a capacity or 10 or more metric tons per day
b. Solid waste recovery/recycling or processing plants having a capacity of 10 or more metric tons per day
c. Solid waste disposal facility having a disposal capacity of 10 or more metric tons per day
d. All toxic and hazardous waste treatment facility or disposal facilities or recycling/recovering

Table 15: Summary of environment regulations under NEA

Regulation	Date	Brief description
National Environmental (Procedure for approval of projects) Regulations No. 1 of 1993	Gazette Notification 772/22 dated 24.06.1993	List of prescribed projects and procedures
Names of State Agencies which are PAAs (EIA)	Gazette Notification Number 859/14 dated 23.02.1995	Lists project approving agencies
EIA amendment (prescribed activities)	Gazette Notification Number 1104/22 dated 5.11.1999	Amendment to prescribed activities.
Order made under Section 23Y - Amendments to the Prescribed Activities.	Gazette Notification Number 1373/6 dated 29.12.2004	Addition to the list of approving agencies
Scheduled waste (hazardous waste) management regulations 2008	Gazette Notification No.1534/18 dated 01.02.2008	Procedures for obtaining an EPL and tolerance limits for industrial waste disposal to inland surface waters, land for irrigation, hydraulic loading for soils, into marine coastal waters, waste from rubber factories, textiles and tanning factories to inland waters, and into sewers.
National Environmental (protection and quality) Regulation (EPL) -1990	Gazette Notification Number 1373/6 dated 29.12.2004 (rescinded by Gazette Notification Number 1534/18 dated 01.02.2008	Alteration of phrases
Amendment to National Environmental (Protection &Quality) Regulations (EPL)-1990	Gazette Notification Number 617/7 dated 2.07. 1990	List of activities for which an EPL is needed
Gazette Notification No.1159/16 dated 22.11.2000 (rescinded by Gazette Notification No. 1533/16 dated 25.01.2008)	Gazette Notification No.1159/16 dated 22.11.2000 (rescinded by Gazette Notification No. 1533/16 dated 25.01.2008)	Amendment to the above
Amendment	Gazette Notification No.1533/16 dated 25.01.2008	Amendment to the above
Amendment	Gazette Notification No.1534/18 dated 01.02.2008	Amendment to tolerance limits/

3.3.Other supporting acts and legislations

Marine Pollution Prevention Act No. 59 of 1981 and its amendment No.35 of 2008

Authorises the Marine Pollution Prevention Agency (MPPA), the Marine Environment Protection Agency (MEPA) since 2009, to implement and take necessary steps to prevent marine pollution in the territorial waters of Sri Lanka. There is a provision for penal action for any form of marine pollution that damages marine resources and marine biodiversity. The amendment of the act strengthened it to implement the obligations of various multilateral conventions such as MARPOL.

Coast Conservation Act No. 57 of 1981 and amendment of 1988: is the main legal instrument for the coastal zone, implemented by the Coast Conservation and Coastal Resource Management Department (CC&CRM). This act and its amendments define the Coastal Zone and set out, in detail, the regulations pertaining to development activities that are permitted and prohibited within this zone. Under this act, the Director of

may request an EIA prior to development activities in the coastal zone.

Flood protection Ordinance (chapter 449): Under this ordinance the relevant minister is empowered to declare any area in Sri Lanka to be a flood area. The Director General of Irrigation Department or any other person designated by the relevant minister shall prepare and carry out a scheme for the efficient protection of such area against floods.

***Colombo District (Low Lying Areas) Reclamation & Development Board Act No. 15 of 1968*:** The Land Reclamation and Development Corporation (SLLRDC) established under this act have power to declare low lying areas within the Colombo district as flood protection areas. The act was amended by Law No. 27 of 1976, Act No. 52 of 1982 and Act. No. 35 of 2006. The low lying areas within this stretch of Kelani River are declared as flood protection area by SLLRDC.

Municipal Council Ordinance 1987: Under Clause 59 of this act a proper officer of the municipal council shall have the power to make, scour, cleanse and keep open all ditches, gutters, drains or water courses along any street and also to make and lay drains, trunks, tunnels for the protection and improvement of streets. The municipal council also has powers to control encroachments. Very comprehensive provisions regarding drainage has been stated under Part VI of the ordinance from Clause 96 to 117 taking drainage as a public health related parameter.

Sri Lanka Disaster Management Act, No. 13 of 2005: An Act to provide for the establishment of the national council for disaster management; The Disaster Management Centre; The appointment of Technical Advisory Committees; The Preparation of Disaster Management Plans; The Declaration of a State of Disaster; Award of Compensation and for matters connected with or incidental thereto.

Urban Development Authority Act: *Amendments Related to Rainwater Harvesting*: A gazette to amend the Urban Development Authority (UDA) drainage laws was passed in Parliament on August 25, 2007. In addition, the regulation has been gazetted on April 17, 2009, which makes rainwater harvesting mandatory in certain categories of new buildings in areas under Municipal and Urban Council jurisdiction.

Irrigation Ordinance (1924), Irrigation Act (1951) and Flood Protection Ordinance (1971): Irrigation Department is mandated for constructing minor flood protection bund and structures along Kelani River, repairing of flood bunds, maintaining of river reservation preventing Illegal occupation at Flood bunds, illegal construction in river banks and reservations and maintaining river reservation.

3.4.Current programmes by agencies

There are a range of ongoing activities by stakeholder agencies in the Kelani River Basin. The KRMP approach capitalizes on these and expected to add value and speed up the restoration work in the KRB.

Table 16: On going activities by agencies related to Kelani River Basin management and conservation

S/N	Ongoing activities	Agency
1	Conservation and management of catchment areas.	Forest Department (FD), Land Use Policy Planning Department (LUPPD), Dept. of Agriculture
2	Protection of river banks	Irrigation Department(ID), Coast Conservation and Coastal Resources Management (CC & CRM) within 2 Km from river mouth
3	Water quality monitoring	Central Environment Authority (CEA), National Water Supply and Drainage Board(NWSDB), Water Resources Development Board (WRDB)
4	Water purification, supply and regulation and sewerage management	NWSDB
5	Developing and Institutionalizing Water Safety Planning(WSP)	NWSDB
6	Regulating sand mining by issuing license	Geological Survey and Mines Bureau(GSMB)
7	Establishment of soil conservation boards in railway stations and beside main roads raising awareness	Natural Resources Management Centre of Department of Agriculture
8	Establishment of soil conservation demonstration sites and awarding for soil conservation activities	Natural Resources Management Centre of Department of Agriculture
9	Management of solid waste	Solid Waste Management Authority, Local Authorities(LAs)/ CEA
10	Education and Awareness	CEA, NWSDB, Education Department, Relevant Agencies
11	Sustainable use of Agricultural lands	Department of Agriculture (DoE)
12	Mapping of land use pattern	LUPPD / CEA
13	Coordination and monitoring of the project activities.	CEA and Ministry of Mahaweli Development & Environment, Ministry of Urban Development & Water Supply
14	Protection of Peak Wilderness Sanctuary	Department of Wildlife Conservation(DWC)
15	Protection of Kelani Valley Forest reserve	Forest Department
16	Protection of Uda Malimboda Forest Reserve	Forest Department
17	Protection of Labugama-Kalatuwawa Forest reserve	Forest Department
18	Protection of Idikada Mukalana forest reserve	Forest Department
19	Implementing Pavithra Ganga Programme	Ministry of Mahaweli Development &Environment
20	Introducing guidelines for drinking water quality and support WSP	World Health Organization(WHO)
21	Establishing a multi stakeholder approach, piloting WSPs for CBO Managed Water, incorporation Water Safety in Education Curriculum	United Nations Children's Fund (UNICEF)
22	Community education programmes	CEA, NWSDB, UNDP/Coca Cola Every Drop Matters

S/N	Ongoing activities	Agency
23	Providing pipe borne water and septage treatment plants, operationalization of the Department of National Community Water Supply, preparation of a comprehensive Water Supply and Sanitation Sector Program and a strategy to mitigate the aggravating effects of drinking water quality on CKDu	The World Bank
24	Conducting related research	International Water Management Institute(IWMI)
25	Support to NWSDB for information dissemination of importance of pipe water conservation and regulation and Kelani river classification from Awissawella to downstream.	Japan International Cooperation Agency (JICA)

3.5.Related national programmes

There are a number of national programmes that have clear links with the KRMP approach. It is necessary to link and articulate synergies between the KRMP approach and national thrust programmes to position the KRMP and also to leverage resources. For example, the Western Region Megapolis Plan (WRMP) includes a number of components proposed in the KRMP action plan.

3.5.1. Haritha Lanka Programme

The first version of the Haritha (Green) Lanka Programme and Action Plan developed by the Council for the Sustainable Development in 2009 is being updated till year 2022 considering the local and international developments including the Sustainable Development Goals (SDGs). The Policy Planning Division of the Ministry of Mahaweli Development and Environment is facilitating the effort that include 10 missions. Mission 07 on "water for all and always" focuses on establishing and strengthening systematic and prioritized water allocation system for various purposes, ensure conservation and protection of all types of water sources and their catchment / reservations and rehabilitation and upgrading the irrigation systems to meet present and future challenges.

10 missions of Haritha (Green) Lanka Strategy

1. Clean Air Everywhere
2. Biodiversity Conservation for Sustainable Development
3. Meeting the Challenges of Climate Change
4. Wise Use of the Coastal Belt and the Sea Around
5. Sustainable Land Management
6. Doing Away with Dumps
7. Water for All and Always
8. Green Cities for Health and Prosperity
9. Greening the Industries
10. Environment Knowledge for Sustainable Development

In addition, the Mission 07 advocates to protect water resources from contamination, integrate conservation, re-use, recharge and recycling practices at all levels of water use, introduce and apply appropriate economic tools/ market based instrument for water polluting industries, strengthen implementation of integrated water resource management systems, reduce water pollution from agro chemicals, by increasing storage capacity and minimize saltwater intrusion.

3.5.2. Combating Land Degradation (2016-2025)

National Action Programme (NAP) for Combating Land Degradation focuses on combating land degradation and mitigating droughts. The objective of NAP is to protect and conserve the Central Highlands which cover the upper watersheds of the rivers to enhance and sustain the water availability and to increase productivity of agricultural and forest lands and to reduce downstream siltation. The program will address the first, second and third strategic objectives of the strategic plan and framework of the United Nations Framework Convention to Climate Change

(UNCCD). There are 25 programs identified for implementation during the 10-year period. Program 5 on Promotion of integrated management of Central Highlands is very much relevant to the KRMP approach.

3.5.3. Sri Lanka Comprehensive Disaster Management Programme 2014-2018

The goal of Sri Lanka Comprehensive Disaster Management Programme (SLCDMP) is to ensure the "safety of Sri Lanka" by reducing potential disaster risks and impacts on people, property and the economy. The overarching objective is to create and facilitate the enabling environment for a multi-hazard, multi-sector, multi-agency partnership oriented disaster management programme, using risk knowledge as the base, in line with global conventions and frameworks.

SLCDMP output 2.14 is on safeguarding water resources from industrial, agro chemicals and domestic point and non-point source pollution. It proposes to appoint a Technical Working Group (TWG) consisting of members from NWSDB, DA, HARTI, ID, CEB, DAD, WRB, CEA, MDM and other agencies responsible for quality and quantity issues of water to identify gaps in the present system of environmental regulations, safeguards and barriers for proper enforcement; develop and commission a number of relevant assessments to support monitoring, reporting and reviewing of environmental health of water resources programmes led by CEA; initiate an Inter-agency consultative process to develop interventions to manage the contamination potential of water resources led by CEA; and Capacity building of agencies to implement the multi-agency pollution prevention system led by CEA to prevent water pollution.

3.5.4. Pavithra Ganga Programme

Pavithra Ganga Programme was commenced in 1998 with the objective of keeping the water bodies clean in the country. One of the major objectives of Pavithra Ganga Program is assisting relevant local authorities to keep the water quality of the main water bodies of the country in acceptable conditions for human use.

Pavithra Ganga Program for the Western Province is implemented for Kelani river as a pilot project by the Sustainable Division of the Ministry of Mahaweli Development and Environment. The programme has established a strong National Steering Committee comprised of key stakeholder entities and carry out a number of activities such as river bank restoration, water quality displays, studies and awareness, among other things.

3.5.5. Western Region Megapolis Plan

Started in 2015 the Western Region Megapolis Plan (WRMP) aims to transform the Western Province as the most vibrant and livable cosmopolitan smart city (Technologically Advanced IT, Transport, Communication, Power and energy) in South Asia based on environmental sustainability and dynamic economic growth ensuring socio-cultural harmony thereby securing its position as the preferred location for business and industry with access to the highest standards of education, health and recreation. This objective is to be achieved through a number of large scale projects.

As about 47% of the Kelani River Basin is located within the WRMP area. Projects under WRMP will not only impact the ecosystem and environment of the basin but also bring more attention to the sustainability aspects Kelani River Basin as the primary water source. The WRMP is being developed using an environment conservation base, therefore, the KRMP team closely coordinated with the WRMP environment group during the development of KRMP. WRMP include a number of KRMP work plan activities.

3.5.6. Punarudaya Programme

Being implemented by Ministry of Mahaweli Development and Environment for a period of 2016 to 2018 the objective of the "Punarudaya" National Programme is to provide an enabling environment for stakeholders responsible for "environment pollution control" and "sustainable land management" to work together.

3.5.7. Blue Green Era: Sri Lanka Next

The Blue Green Era is the latest Government initiative towards sustainable development of Sri Lanka, launched along with the first year anniversary of H.E. the President Hon. Maithripala Sirisena. The Blue Green Era is expected to be an umbrella strategy and action plan that include all sustainable development efforts of the Government including the meeting of challenges of climate change. Therefore, almost all current and future programmes and projects will be redefined under this new theme.

3.6.Adopting Nature Based Solutions

Nature based solutions introduced by IUCN is one of the globally accepted thrusts to balance development and conservation, the same context the KRMP approach was based.

Nature based solutions or NATRUE+ do not say "No" to development. Instead it proposes to work with development with better understanding and use of science and enhanced participation leading to balanced development. It brings Nature into programming approaches as the best way to manage and conserve natural capital while providing for the increasing needs and meeting the challenges of climate change.

Key components of Nature based solutions are:

Nature + Development: Social and Economic development going hand in hand with nature conservation.

Nature + People and Governance: Effective and equitable governance of nature's use.

Nature + Food: Sustainably meeting the needs of people, especially the poor.

Nature + Life: Valuing and conserving nature the very foundation of our own wellbeing and ultimate survival.

Nature + Climate: Nature based solution to meet the climate challenges both in terms of mitigation and adaptation.

The proposed KRMP approach and design has taken the NATURE + into account in its design and proposes that the same principles to be upheld during the implementation of the KRMP approach.

Chapter 04: KRMP Design Approach

4.1. Management Objectives and Key Results Areas

The Medium to Long-term Multi-Stakeholder Strategy and Action Plan for Management and Conservation of the Kelani River Basin or the Kelani River Basin Multi-Stakeholder Partnership (KRMP) approach, in short is designed to include five Management Objectives (MOs).

Table 17: Management Objectives of KRMP approach

Management Objective		Description
A		Land use management for source water protection and sustainability
B		Industrial and Urban Management for Pollution Control and Sustainability
C		Research, Studies, Awareness, Training and Education for Better Management and Conservation
D		Operationalizing, Monitoring and Evaluation of the Kelani River Basin Management and Conservation Plan
E		Public Private Partnerships contributing towards the sustainability of Kelani River Environment

The work plans in Chapter 5 are based on the five Management Objectives and each management objective has its well defined objective, outcome and one or more Key Results Areas (KRAs). Monitoring and Evaluation is designed based on Management Objective areas including the baseline establishment and updating for the operational purposes and to strengthen the monitoring of the implementation of KRMP activities, the five Management Objectives were further expanded using ten Key Results Areas (KRAs). These 10 Key Results Areas are expected to facilitate agency/stakeholder coordination.

In addition to the Management Objectives and Key Result Areas, the KRMP activities are also divided into three programming scales as explained later in this Chapter.

1. Programmes by Govt. Technical Agencies
2. Programmes supported through Public – Private Partnerships
3. Programmes at minor-watershed level

This structure and design is expected to empower and provide room for local and international agencies, private sector, and communities to work together towards broader management and conservation objectives and generate the momentum which may change the way natural resources are being use.

Table 18: Descriptions of 10 Key Results Areas (KRAs)

Management Objectives (MOs)	KRA	KRA Description
MO- A		KRA 1: Agriculture practices do not contribute to water pollution and land degradation
		KRA 2: Land use policies and practices promote sustainable land management
MO- B		KRA 3: Policies, licensing approaches and management practices minimize industrial pollution
		KRA 4: Improved waste, sewerage and storm water management in urban areas minimize pollution loads
		KRA 5: Updated disaster preparedness capacity in Kelani River Basin agencies and communities improves resilience
MO- C		KRA 6: Research and development and targeted studies add value to river basin management and conservation
		KRA 7: Awareness, Education and Training empower stakeholders including communities
MO- D		KRA 8: Coordination, monitoring and evaluation capacity facilitate implementation
		KRA 9: Integration of climate, gender, vulnerable groups improve equity and sustenance
MO- E		KRA 10: Public Private Partnerships add value, enhance resource base and improve sustainability

4.2. Management Objectives in detail

Management Objective A: Land use management for source water protection and sustainability

Objective: Promote sustainable land use patterns and related policy decisions towards adoption of best practices including better enforcement

Description: Policies and practises on land uses affect the soil-water-environment related pathways by altering surface runoff, groundwater recharge, sediment and pollutant transport etc., thereby changing the quantity and quality of water resources plus the associated ecosystem services. The main focus of this area is to address land based non-point and point source pollutions primarily associated with agriculture (sediments, nutrients, pesticides, pathogens etc.), illegal sand and gem mining, encroachments, unplanned development, forest degradation, and inappropriate land use practices that are not matching with the best potential land use for a given land parcel/region.

The possibility exists to work on a number of policy and legislative improvements including fertilizer use, buffer zone management, land ownership, land degradation etc., in addition to field activities.

The proposed set of activities under this MO are designed to ensure the rational land use for source water protection and sustainability through improved land use polies and planning

while strengthening enforcement mechanisms and decision making tools. Activities in this area will also be supported by a strong educational, awareness and information system.

Key Results Areas (KRAs) under Management Objective A:

KRA 01: Agriculture practices do not contribute to water pollution and land degradation

KRA 02: Land use policies and practices promote sustainable land management

Expected outcome: Rational land use in KRB ensures source water protection, integrated sediment management and sustainability (*Indicator/s: 50 % of land area in the KRB is positively influenced by land use improvement activities through the KRMP activities*)

Management Objective B: Industrial and Urban Management for Pollution Control and Sustainability

Objective: Improve the capacity to manage industrial environment systems and urban service delivery towards better pollution control, disaster preparedness and enforcement.

Description: Industrial discharges, storm water and sewerage related pollution, deficiencies in preparedness to manage disasters/risks are the key areas addressed in the Management Objective B.

The activities are expected to improve environment management systems in industry, urban and local authority service delivery, infrastructure development (roads, irrigation, mini-hydro etc.) and adoption of multiple BMPs towards better enforcement, compliance, pollution reduction with enhanced resilience.

Early action to mitigate the pollution risks has the potential to avoid serious disruption to the functioning of the communities, industries and ensure reliable socio-economic conditions. In order to achieve desirable results, the co-ordination and co-operation of Govt., Private, Non-Govt. and Civil Society entities are very much needed. Therefore, the activities in this area are designed to encourage partnerships.

With over 10,000 industries in the Kelani River Basin it is necessary to focus on the industrial sector related pollution risks, extensively. Although minimal it may be necessary to re-locate a number of "A" type industries to suitable locations and also provide additional facilities in existing and new industrial zones. Similar considerations are included in the Western Region Megapolis Plan (WRMP).

Environmental Audits, Environment Management System (EMS) improvements and enforcement of Environment Protection Licenses (EPLs) process may improve the industrial performance and pollutant loading to the stream system. In this process it is necessary to work towards "zero" pollution eliminating the need for "polluters to pay" as it implies that pollution to a certain degree is acceptable.

In addition, the proper management of municipal/ domestic waste/sewerage and storm water runoff may reduce the current pollution levels, including the management of waste water treatment plants. Adoption of BMPs and technological advances in this area are promoted through the activities under MO-B.

Key Results Areas (KRAs) under Management Objective B:

KRA 03: Policies, licensing approaches and management practices minimize industrial pollution.

KRA 04: Improved waste, sewerage and storm water management in urban areas minimize pollution loads

KRA 05: Updated disaster preparedness capacity in Kelani River Basin agencies and communities improves resilience

Expected outcome: Improved industrial environment management and urban services plus infrastructure improvements reduces pollution *(Indicator: Minimum of 75% of industries and urban units participate in KRMP related pollution management and reducing threats to environment and human health)*

Management Objective C: Research, Studies, Awareness, Training and Education for Better Management and Conservation

Objective: Generate, share and use of scientific knowledge and best management practices to support Kelani River Basin Multi Stakeholder Engagement.

Description: The focus of the Management Objective C area is to strengthen the enabling environment for KRMP approach implementation through enhanced scientific knowledge/evidence on pollution trends, better understanding of environmental degradation and causes plus targeted awareness, education and training.

Stakeholder entities involved in this capacity development cover all types of groups extending from national agencies down to communities with media, private sector, universities etc. in between.

The purpose is to build the necessary capacity and knowledge to ensure the KRMP approach is knowledge driven during design, implementation and sharing lessons learnt. This may also require additional studies, research and exposure events.

The education work targeted to students and the activities are expected to inform and empower communities through the CEA led Environment Pioneer Programme. CEA and NWSDB along with WRB are the key technical resource providers.

Among the initiatives there could be facilities to provide research grants, hold competitions to promote knowledge, and opportunities for Universities, Graduate Students and Interns to work on different topics that are relevant.

There is a long list of potential research and assessments already compiled through this planning process, covering, land use studies, assessment of ground water quality, impacts of pesticides and agricultural chemicals, assessment of fauna and flora, pollution load estimations, economical evaluation of ecosystem services, gender studies, nature based solutions, perception surveys, etc.

These studies and research can be integrated for better results in areas such as sediment management, agriculture and land use, industrial environment management systems, infrastructure, payment for ecosystem services, human health, gender perspectives, climate change etc.

Key Results Areas (KRAs) under Management Objective C.

KRA 06: Research and development and targeted studies add value to river basin management and conservation

KRA 07: Awareness, Education and Training empower stakeholders including communities

Expected outcome: Stakeholder groups are empowered with appropriate knowledge to successfully participate and adopt management and conservation practices *(Over 50% stakeholder groups are aware of health - pollution linkages and scientific approach of KRMP for management and conservation of KRB)*

Management Objective D: Operationalizing, Monitoring and Evaluation of the Kelani River Basin Management and Conservation Plan

Objective: Enabling environment and capacity to support stakeholder agencies and others to achieve KRMP goals ensured.

Description: Well-coordinated, technically sound and adequately resourced operational mechanism is needed to ensure the successful implementation of the KRMP approach.

The system proposed include a credible governing body ably supported by an efficient Secretariat equipped with modern tools such as a content management system, information sharing modalities and an elaborate Monitoring and Evaluation support.

The multi-stakeholder approach of KRB management and conservation also require client oriented approaches, advocacy and continuous use of effective communications approaches covering stakeholders at national and grassroots levels.

The coordinating and operational mechanism is expected to work with Government (Cabinet of Ministers, Senior Govt., National Planning, Public Administration, Local Government etc.) on administrative matters, private sector on partnerships and non Govt. and Civil Society Organization on programme interventions.

Key Results Areas (KRAs) under Management Objective D.

KRA 08: Coordination, monitoring and evaluation capacity facilitate implementation

KRA 09: Integration of climate, gender, vulnerable groups improve equity and sustenance

Expected outcome: Successful KRB management and conservation implementation model that can be replicated in other river basins *(Indicator: More than 75% Govt. stakeholder agencies are on track in implementing KRB plan)*

Management Objective E: Public Private Partnerships contributing towards the sustainability of Kelani River Environment

Objective: Improved private sector involvement in KRMP approach through staff participation, resources, technology and innovative partnerships.

Description: The Kelani River Multi-Stakeholder Partnership (KRMP), as the name implies, encourages public-private partnerships extending to public-private-community partnerships. These partnerships can cover all scales, namely, the basin, sub-basin and minor-watershed levels. It is envisaged that these partnerships provide the sustainability and innovation to the Kelani River Basin management and conservation.

This Management Objective and the Key Results Area (KRA), therefore, consists of a range of initiatives. For example, this KRA includes larger initiatives like “Hazardous Waste Free Basin – a systematic approach to collect and dispose hazardous chemicals, electronic waste, unused drugs and non-degrading laminated materials etc.”, “Biogas Basin of Sri Lanka – promoting biogas making using food waste, waste water, septic waste etc. at different levels such as restaurants, offices, public buildings, community level household etc.”, “Want not Waste Not – promoting reducing, recycling, reuse etc.”

In addition, there is room to incorporate internationally recognized approaches such as “Healthy Parks and Healthy People” a creative educational, psychological and health improvement programme developed in Australia and presently implemented around the world or school programmes such as

"Stockholm Water Junior Price (SWJP)" where students do environment projects for a national and global competition to name a few.

Discussions in this regard with private sector entities have been extremely encouraging. While supporting and participating in basin level initiatives, a number of companies are keen in participating and supporting the local level minor-watershed restoration, education and awareness where their factories and facilities are located and most of the employees are from the vicinity.

Key Results Areas (KRAs) under Management Objective E.

KRA 10: Public Private Partnerships add value, enhance resource base and improve sustainability

Expected outcome: Deployment of sustainability concepts and CSR through partnerships with active participation by private sector *(Indicator: At least 50% of the private sector entities located in the Kelani River basin are engaged positively in Public Private Partnerships in the KRB management and conservation)*

4.3 Cross cutting areas

Human Health: KRMP will focus much on preparing public on health issues and promote policy level attention including the targeting of investments towards risk reduction and multi-sector coordination. As there are a number of water borne diseases and health impacts due to water pollution involvement of Public Health Inspectors (PHIs), District Medical Officers (DMOs), Provincial Health Directors, Divisional Health Services Directors and other health authorities is important in the KRMP.

The minor-watershed level programmes proposed are expected to facilitate the involvement of health sector much in the planning, implementation and monitoring.

Gender perspectives: Gender refers to the socially assigned roles and responsibilities for men and women in a given society in a given time. For example, if pipe born water is not available, women often assume the role of supplying water to the family as men often times engage in economic activities. Further the activities of men contribute towards deforestation and major land use changes and whole family including women and children face water shortages. Such differences of men and women should be considered for effective engagement of both men and women in environment management and conservation in the KRMP approach.

KRMP approach promotes women's participating in monitoring the programmes at sector, basin, sub-basin, minor-watershed levels, while supporting their gender specific needs including, safety, resilience and privacy. Related awareness and training programmes should be conducted at a convenient time and place accommodating children as required. Women's representation and capacities at all levels needs to be considered and promoted to enhance the involvement of female officers as well as female community members in the management and conservation of Kelani River Basin and in making decisions on human and ecosystem health.

Climate Change: In the areas of ensuring human well-being and ecosystem health the climate change adaptation related interventions can play a vital role. For example, decision making on drinking water, industrial, urban and agriculture needs are largely affected by seasonal availability of surface as well as ground water all of them are climate related. KRMP emphasize the need to mainstream climate change predictions and other concerns due to changes such as rainfall, temperature, growth of invasive species etc. in its programmes and projects. Climate change is expected to increase the rainfall in Kelani River Basin.

4.4. Programming approach

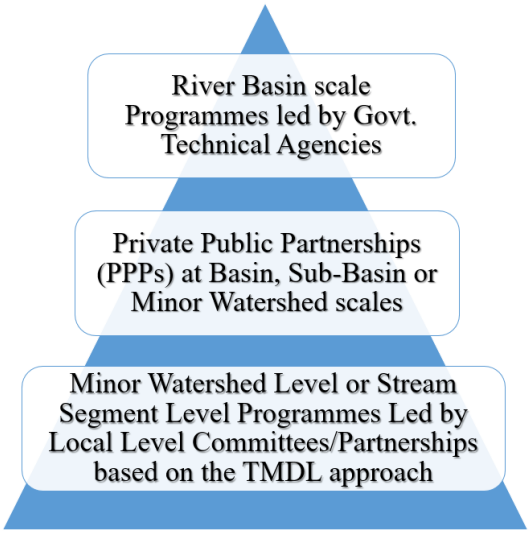

Figure 25: Three level programming approach

The KRMP approach proposed is a combination of bottom-up and top-down approaches with Public-Private Partnerships playing a key role at all levels.

The top-down approaches are primarily led by Govt. Agencies and the bottom-up approaches are mostly the local level or minor-watershed level activities led by stakeholder groups related to the given local or minor-watershed level.

This hybrid approach is expected to bring the required effectiveness, efficiency and coordination to deliver the larger goals of the KRMP approach and allow private sector to play a key role supporting the programmes.

4.4.1. Top-down approach

This segment is comprised of the Programmes and Projects by national level technical agencies as per the work plan elements presented in Chapter 5. Most activities will envelop the entire Basin. Activities will extend from policy changes to promotion of best practices to capacity development, therefore, contribute significantly towards the creation of a strong enabling environment for management and conservation of the Kelani River Basin.

Resources for the programmes/projects will be partly from the provisions from the national budget to Govt. agencies (as indicated under activities as earmarked) and mobilized through donor assistance.

4.4.2. Public-Private Partnerships (PPPs):

These partnerships may function at all levels, namely, the ***basin, sub-basin and minor-watershed*** levels.

Public–Private Partnerships could work on specific topics such as basin wide management of “electronic waste” or work on promoting best practices such as “biogas or composting” and much more depending on the participation, innovation and commitment.

The overarching objective of PPPs are to empower, provide space and engage private sector in management and conservation while creating a culture of social responsibility among public sector, private sector and local communities.

This PPP approach is expected to bring companies whose facilities are located within and outside the basin to work with agencies and communities, hand in hand.

Based on the consultations with the Private Sector number of companies are keen in working in the communities where their work force is residing.

The Management Objective E of the Strategy and Action plan and Key Result Area 10 are dedicated to the work through PPPs.

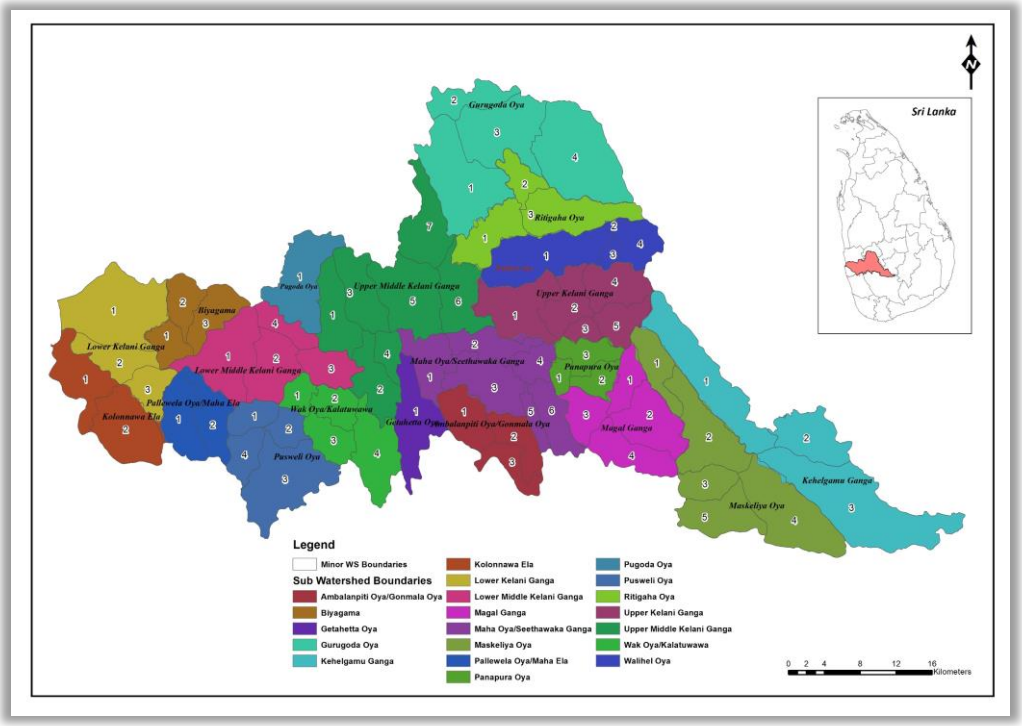

Figure 26: Minor - watersheds in the 20 sub-watersheds
Source: IUCN based on Survey Department contour data

4.4.3. Bottom-up minor watershed level programming:

The targeted geographic level is the 71 minor-watersheds in the Kelani River Basin in the 20 sub-watersheds. In this level a range of initiatives for management and conservation can be identified based on the "sources of pollution" covering both point and non-point sources.

KRMP approach relies significantly on the decentralized pollution prevention approach using minor-watersheds. There are a number of important considerations that are useful in setting up the enabling environment to identify the type of pollutants relevant best management practices to be adopted by minor-watershed level stakeholder groups, with the assistance of many technical agencies and universities.

4.5. Minor-watershed level programming

The programming at minor-watershed level starts with mapping the key stakeholder groups at the minor-watershed level and establishment of pollution management task force or a group with an agreed structure allowing the participation of all parties.

Together with stakeholder representatives, the health of the minor-watershed is assessed based on water quality monitoring of selected parameters and physical observations. To be realistic the monitoring of the minor-watersheds takes about a year covering all seasons.

It is necessary to agree on the cut off limits for different parameters to determine whether the watershed health is poor or impaired. CEA is the quality assurance agency for this process of recommending standards and the decisions on the determination of minor watershed health.

Once the type of pollutants causing the water quality to deteriorate beyond a prescribed limit is noted the joint stakeholder group and technical experts with the help of CEA can determine the amount of permissible level of pollution allowed to bring the watershed back to a sustainable level which is in line with USEPA method of pollution load reductions based on a Total Maximum Daily Loading Limits (TMDL) approach. Monitoring both flow and water quality is important to compute the loads of pollutants and to design pollution control practices.

4.5.1. TMDL approach

Total Maximum Daily Load (TMDL) approach is initially developed by the United States Environment Protection Agency (USEPA) for restoring and management of impaired watersheds, considering both point and non-point sources of pollutions.

TMDL approach is based on the determination of the maximum pollutant amount (both point and non-point source pollutants) that a given waterbody may receive without exceeding prescribed water quality standards.

The TMDL process relies extensively on water quality monitoring to identify firstly whether the watersheds are impaired and secondly with what pollutants.

If impaired by a certain pollutant the focus is to develop and implement best practices to bring down the pollution level necessary to make the watershed non-impaired.

Adopting the TMDL Approach for the Kelani River Basin we may consider two levels, namely, the Sub-Watershed level (20) or Minor-Watershed Levels (71).

Based on the historical data and the size of sub-watersheds, it is logical for us to opt for the minor-watershed level in order for the approach to be effective and efficient in identifying and managing different pollutant types, sources and impacts.

In addition to focusing on water quality the local level stakeholder groups may focus on other local level issues that are pertinent such as waste management, flooding, encroachments and alternative livelihoods plus recreation opportunities using the natural resource base they are involved in planning.

The TMDL approach needs the measurements of both periodic concentration of selected parameters (bi-weekly preferred) and flow (daily) measurements at a given watershed.

At the minimum the outlet of the particular minor-watershed needs to be monitored for pollution and flow. During the first year of monitoring (to cover all seasons) the focus can be on the outlet of the minor-watershed and depending on the findings from second year onwards the additional measurements can be introduced based on the level and types of pollution. For example, in the event the minor-watershed is impaired badly the number of monitoring points could be increased to help manage relevant point or non-point source pollutions. If the watershed is not impaired a regular monitoring can continue to capture/evaluate potential or emerging issues.

During the initial year of implementation of the TMDL introduction at the minor watershed level it is proposed to carryout bi-weekly sampling of total Phosphorous, ortho-phosphorous, ammonium nitrate, total nitrogen, turbidity, pH, BOD, DO, COD, cadmium, mercury, lead, copper, nickel, oil and grease, total coliform and fecal coliform at each 71 minor-watershed confluence points. This list may slightly vary based on additional information that would be available at the time of implementation.

Flow measurements needs to be taken daily at the outlet of each minor-watershed (71

locations). Reading of flow gauges can be done by the communities or schools.

With regard to the decision making on watershed impaired condition, it is proposed to use the CEA prescribed limits (develop if not available) and analyze the percentage of times a particular pollutant exceed the standard.

In concurrence with CEA the minor-watershed management team can use the cutoff point for a given minor-watershed to be considered non-impaired when over 80% samples are meeting the prescribed standards. For example, if over 20% of turbidity measurements (from biweekly measurements) are exceeding the standards that minor-watershed is considered as impaired in terms of turbidity. Similarly, decisions on impairment can be done for other pollutants too.

At the end of first year of operation, it is possible to identify the minor-watersheds that are impaired and the type of pollutants causing the impairment.

Further a load estimation (a spreadsheet calculation or modeling) will help decide the extent of pollutant reduction measures needed to meet the criteria for impairment for each pollutant, in the impaired watershed.

Then the management plans are needed to be developed using the guidelines of best practices to bring down the level of pollution to an acceptable level determined collectively by minor-watershed management and CEA based on the TMDL approach. University inputs, local and global knowledge and project developed guidelines can be used to identify the best practices.

After completion of the first round of implementation and continuous monitoring, for example at the end of second year of implementation, the approach can be repeated until all parameters or pollutants are under control and water quality is within the limits. Once the non-impaired condition is reached for all pollutants, the watershed monitoring is continued for the purpose of ensuring the status of watershed remains at non-impaired.

This type of local level programming may allow local level stakeholder groups to focus on certain areas as oppose to apply solutions across sub-basins or at the basin level, based on the identified issues (using water quality and other environment observations/measurements), thereby, optimizing the resources needed.

As indicated the minor-watershed level programming can be supported by private sector to a greater extent along with local authorities including the health officials getting involved.

The material developed on communications, best practices (composting, biogas, wetlands, recycling, bank restorations, organic farming, green jobs etc.), technology/infrastructure interventions such as waste management, central sewers etc. and innovative programmes such as “healthy river-healthy people” awareness and education plus champion recognition at local levels can add value.

The minor watershed programmes can add up to sub-basin and basin level through the proposed secretariat and progress can be monitored, improved and rewarded.

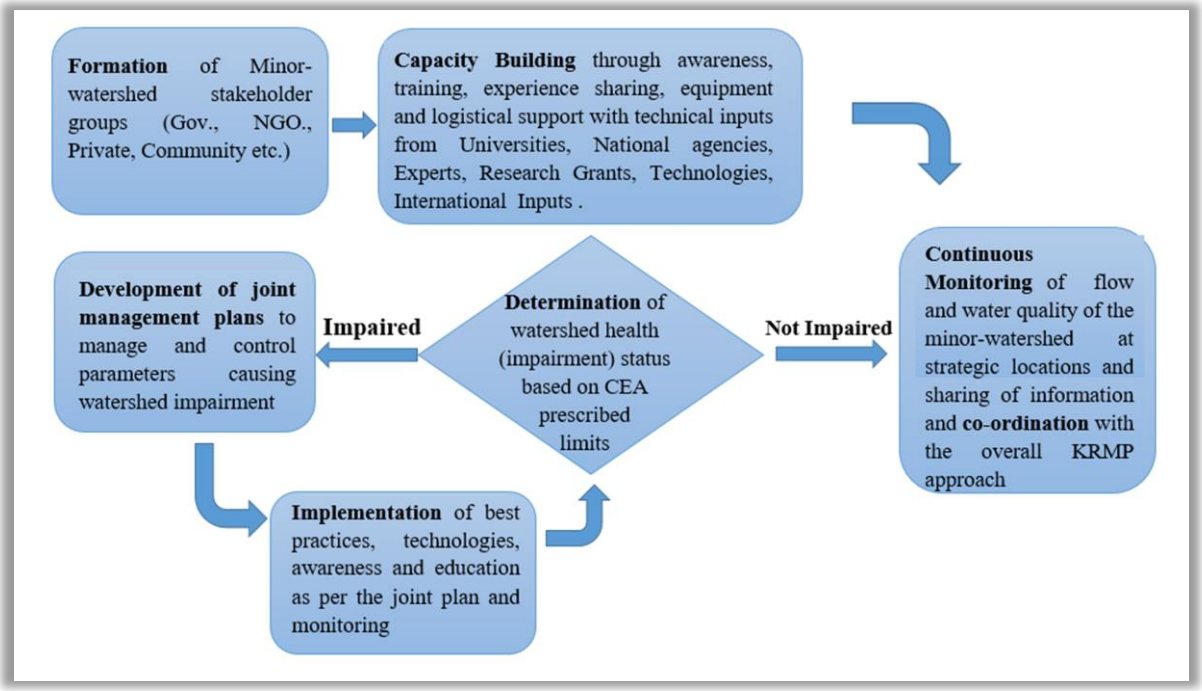

Figure 27: Local level (minor-watershed) planning and implementation processes

Since the TMDL approach is an iterative approach it is necessary to maintain the monitoring even though a minor-watershed is identified as non-impaired to capture any emerging pollution issues.

In order to facilitate the TMDL based minor-watershed approach, it is necessary to develop the capacities and awareness of the stakeholder groups and communities on a) the type of pollutant; b) potential sources; c) mitigation options; d) technologies or best practices available; and e) implementing modalities to be adopted. Therefore, it is important to develop environment knowledge products and detailed guidelines and general awareness material such as health aspects of pollution, by the project. The plans may have similarities and complementary aspects with standard "Water Safety Plans (WSPs)" but will include detailed technology interventions, roles and responsibilities, and monitoring mechanisms.

4.5.2. Minor-watershed stakeholder roles

The composition of the stakeholder group may depend on the size of the watershed, local authorities and district administration represented, other key players present as well as the key issues to be addressed.

Key categories of stakeholder groups may include those who are responsible for implementing the watershed plan; affected by implementation of the watershed plan; having information on the issues and concerns in the watershed; knowledgeable or implementing interventions; capable of providing technical and financial assistance, among others. Also the stakeholder groups can be expanded anytime based on the programme requirement and stakeholder interests.

Land use…

Urban…

Industrial ...

Source: Thilakaratne and Mallawatantri, Unpublished, 2013

Chapter 05: Action Plan

5.1. Summary of the action plan

The action plan developed and presented in this **Medium to Long-term Strategy and Action Plan for Management and Conservation of the Kelani River Basin** to be implemented using the proposed Kelani River Multi-Stakeholder Partnership (KRMP) approach are a result of a systematic consultative process which is comprehensive and analytical. Key inputs included:

The work plan included 65 activities totalling about Rs. 7,900 million (about 54 million USD) for a five-year period between 2016 to 2020.

As indicated (chapter 4) the work plan is designed under five Management Objectives and 10 Key Results Areas. It is also proposed to review the activities periodically (annually) to adopt necessary changes emerging during the implementation.

Table 19: Summary of KRMP activities by Management Objective areas

Management Objective Area	Number of activities	2016 SL Rs. millions	2017 SL Rs millions	2018 SL Rs millions	2019 SL Rs millions	2020 SL Rs millions	Total SL Rs millions	Total USD millions
Management Objective A- (includes KRAs 1 and 2): Land use management for source water protection and sustainability	**16**	201	416	466	377	357	**1,816**	**12.5**
Management Objective B - (includes KRAs 3, 4 and 5): Industrial and Urban Management for Pollution Control and Sustainability	**12**	968	1,683	497	301	291	**3,740**	**25.8**
Management Objective C- (includes KRA s 6 and 7): Research, Studies, Awareness, Training and Education for Better Management and Conservation	**17**	357	373	219	210	208	**1,367**	**9.4**
Management Objective D - (includes KRAs 8 and 9): Operationalizing, Monitoring and Evaluation of the Kelani River Basin Management and Conservation plan	**13**	125	122	101	101	101	**550**	**3.8**
Management Objective E - (includes KRA 10): Public Private Partnerships contributing towards the sustainability of Kelani River Environment	**11**	73	102	80	72	72	**399**	**2.8**
TOTAL	**69**	**1,724**	**2,696**	**1,363**	**1,061**	**1,029**	**7,872**	**54.3**
Total in US Dollars (USD = 145 SL Rs.)		**11.9**	**18.6**	**9.4**	**7.3**	**7.1**	**54.3**	

Medium to long-term multi-sector, multi-stakeholder strategy and action plan for management and conservation of the Kelani River Basin (2016-2020)

Guide to activity tables:

Activities are numbered under Key Results Areas

e.g.: KRA1-A1 indicates Activity 1 under Key Results Area One – given as "KRA-1"
similarly KRA10–A1 indicates Activity 1 under Key Results Area 10

5.2.Action Plan

5.2.1. Management Objective A activity details

Land use management for source water protection and sustainability

Objective: Promote sustainable land use patterns and related policy decisions towards adoption of best practices including better enforcement

Expected outcome: Rational land use leading to source water protection, integrated sediment management and sustainability ensured

Key outcome indicator/s: 50 % of land area in the KRB is positively influenced by land use improvement activities through the KRMP activities

Issue/s: Agriculture and land degradation related pollution including sediments, Fertilizer and pesticides, Illegal sand and gem mining, Encroachments and unplanned development, Deforestation and forest degradation, Inappropriate land use practices not matching land and landscape characteristic, Potential impacts on wildlife and Policy, Institutional and implementation gaps.

Baseline data required: Updated land use, sub basin characteristics, climate information, industrial categories and infrastructure, pollution information, legislative and institutional information/mechanisms, type and extent of pesticide and other agricultural chemical use, water quality and quantity information regarding the basin, sub-basin and stream levels.

KRA No - Activity No.	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
KRA 01-A1	Management and control of agriculture related pollution (*Already estimated budget by DA - Rs. 0.5 million per annum for five years*)	a) Assessing the policy, institutional and implementation barriers, information and awareness gaps, and design potential approaches; b) Identifying and implementing priority actions; c) Annual review, feedback and corrective actions	a) Barriers identified; b) Mechanisms in place to address priority barriers; c) Annual assessment and progress report on enforced regulations and documented impact/s of interventions feeding to activity 1.2.	Department of Agriculture, Registrar of Pesticides, National Fertilizer Secretariat, Land Reforms Commission, Provincial Land Commissioners, Divisional Secretaries	Department of Agriculture (DA), Department of Agrarian Development (DAD), Central Environmental Authority (CEA), Univresities	5	50	100	50	50	**255**

KRA No - Activity No.	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
KRA 01-A2	Promotion and mainstreaming of eco-friendly viable and sustainable agricultural best practices (*Already estimated budget by DA - Rs. 11 million for 2016 to 2020*)	d) Review present practices; e) Identify less polluting, water and energy efficient agricultural best practices; f) Support agricultural officers and farmers to implement such practices through pilot initiatives including urban gardens; and g) Documenting results of eco-friendly farming (e.g.: DA extension on organic farming; Ceylon Tobacco Company Sustainable Agriculture Development Programme)	a) Appropriate practices for different agro-ecological systems and landscapes identified; b) Annual implementation progress review, report and programme adjustments	Department of Agriculture, Department of Agrarian Development, Provincial Councils, Private Sector, Local Authorities (LAs), Divisional Secretaries	DA, DAD, CEA, Land Reforms commission, Provincial Land Commissioners and Private Sector leading greening initiatives, Universities	10	30	40	40	30	**150**
KRA 02-A1	Management, conservation and sustainable use of low-lands/wetlands including urban wetlands and associated ecosystems	a) Review literature and studies and identify the services performed by key wetlands in the basin by location; b) Develop a mechanism to include wetland services in management and conservation of the KRB including ecotourism, waste water treatment and education and awareness etc.; c) Pilot initiatives on BMPs based on local and global practices; d) Annual review of the use and benefits of wetlands	a) Integrated approach to use wetland services in KRB management; b) Evaluate the functions of wetlands and contributions; c) Policy and other recommendations to enhance the wetland services. Note: This activity may have links with WRMP.	SLLRDCC, UDA, Divisional Secretaries, Local Authorities (LAs), Private Sector, Schools and Communities	Ministry of Industries, Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Ministry of Land, CEA, NWSDB, Universities	20	50	50	50	50	**220**

KRA No - Activity No.	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
KRA 02-A2	Improved sand estimation process and co-ordination to meet sand requirement for large scale projects in advance *(Already estimated budget GSMB- Rs. 2.5 million for 2016-2020)*	a) Coordinated mechanism established to estimate sand requirement for large scale projects; b) Implementation of a systematic approach to use licensed suppliers or alternate sources (sea sand) to provide sand in an environmental friendly manner; c) Linkages with other projects and programmes; d) Approve and monitor the implementation of decided options; e) Information sharing system to support the estimates, use and corrective actions	a) Sand requirement coordination mechanism in place; b) Information sharing system for monitoring in place; c) Agency agreed environmentally sustainable sand supply for large scale projects documented; d) Feedback mechanism and corrective measured	GSMB, Relevant Quantity Surveying Companies (QSCs), Divisional Secretaries, BOI, National Chamber of Construction Industries (NCCI)	Ministry of Industries, Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Ministry of Land, CEA, Leading contractors	10	8	8	5	5	**35**
KRA 02-A3	Systematic sand mining in line with regulations on limiting/preventing sand mining (*Already estimated budget GSMB- Rs. 4 million for 2016-2020*)	a) Conduct the annual sand survey in every November (immediately after the south west monsoon) to estimate availability of river sand for issuing sand mining and transportation license in next January; b) Renew sand mining license in every six months after a quick sand survey in every March in selected locations; c) Enforcements on limiting/preventing sand mining; d) Information sharing system developed	a) Annual sand survey report; b) Updated online data base linked to DS divisions and other relevant institutions (every six months) on renewed licenses	GSMB, Divisional Secretaries	Department of Land Use Policy Planning (LUPPD), Survey Department (SD), Ministry of Environment; Disaster Management Centre	2	2	2	1	1	**8**
KRA 02-A4	Establish a sand mining monitoring police unit at GSMB for monitoring unlawful license, sand mining and transportation *(Estimated budget*	a) Establishing of police monitoring unit at GSMB; b) Development of an information sharing system with key agencies; c) Targeted awareness related to enforcement	Annual assessment and progress report on cases recorded and actions taken	Divisional Secretaries, Local Police and GSMB	CEA, Environment Police of Sri Lanka Police Department Media	8	5	5	5	5	**28**

KRA No - Activity No.	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
	GSMB- Rs.13 million for 2016-2020)										
KRA 02-A5	Promote alternative livelihoods for illegal sand and gem mining *(Already estimated budget GSMB- Rs. 4 million for 2016-2020)*	a) Identification of target groups to be provided with alternative livelihoods; b) Assess available opportunities and potential for creating new opportunities; c) Develop an implementing plan through a public, private, community partnerships including Govt. subsidy and training schemes; d) Operationalize the approach	a) Alternative employment opportunities generated; b) Trainings conducted; c) Establishment of public, private, community partnerships; d) Annual assessment and progress report on promoted alternative livelihoods for illegal sand and gem mining	Ministry of Social Services, Divisional Secretaries, Vocational Training Institutes and Private Sector	Geological Survey and Mines Bureau (GSMB), IDB Development Board, Export Development Board, Small and Medium Enterprise Development Support (Laksala, Dept. of Small Industries) Local Authorities (LAs), CEA	20	20	20	20	20	**100**
KRA 02-A6	Eco-friendly technologies and best practices for mineral extraction promoted. For example, crushed Quarts, Granite and Clay *(Already estimated budget GSMB Rs. 10 million for 2016-2020)*	a) Identification of relevant technologies with cost estimates; b) institutional and operational arrangements established for promotion/adoption of environment friendly economically viable technologies including pilots; b) Training awareness and capacity building; c) Incentives for investors and banks to lend for eco-friendly methods; d) Best management practices to use the quarries after mining	a) Number of best practices and technologies promoted; b) Quantities of different minerals produced via eco-friendly approaches; c) Post-mining best practices monitored and documented; d) Number of related investments; e) Review and system improvements	GSMB, Divisional Secretaries, Nano Technology Institute, COSTI	CEA, ITI, EDB, Cement Companies, Ministry of Industries, Universities and Technical Institutions conducting research on equipment and waste minimization of minerals during mining	10	20	20	20	20	**90**
KRA 02-A7	Systematic and Integrated Sediment Management to manage/prevent river bank erosion including those in tributaries *(Already estimated budget GSMB- Rs. 0.5 million for 2016-2020)*	a) Derive critical sites based on the sand survey, site visits and remote sensed methods; b) Establish a multi-agency mechanism for integrated sediment control; c) Planned approach for conservation of river banks including a buffer zone and bank restoration approach;	a) Develop a multi-agency mechanism for sediment management; b) Improve and expand the annual sand survey report to include erosion sites and causes to share with the relevant agencies;	GSMB, LUPPD, DA, DAD, Divisional Secretaries and Local Authorities	CEA, Survey Department, Irrigation Department, ICTA, IWMI, Universities, Ministry of Land and Land Development and Media, Private Sector and CBOs	30	70	60	50	40	**250**

KRA No - Activity No.	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
		d) Annual review and improve mechanism/s with links to LUPPD coordinated source water protection approach	c) Map based information sharing system; d) Buffer zones established								
KRA 02-A8	Support to implementation of the National Policy on Protection and Conservation of Water Sources, their Catchments and Reservations (gazette no.1894/3 - 22/12/14) along with Land Ordinance, Irrigation ordinance and other related laws (*Already estimated budget LUPPD- Rs 8.5 million for 2016-20)*	a) Develop 1: 10,000 or 1: 50,000 maps to support assessing the current status on land uses in Kelani River Basin and identification of pollution sources; b) Support the Activity 1.9 on buffer zone conservation mechanism; c) Support implementation of the policy, laws and regulations related to management and conservation of Kelani River basin in line with the gazetted mandate; d) Share information with relevant agencies via a common content management system	a) Areas that need conservation identified including buffer zone areas; b) Multi-stakeholder management for conservation supported including the coordination; c) Annual evaluation of the progress and improvements	Ministry of Land, LUPPD ID, CEA, NWSDB and other related agencies	Other related agencies, Universities, Private Sector, Legal NGOs and CBOs	5	5	5	5	5	**25**
KRA 02-A9	Transfer the land ownership of the lands currently cultivated by Forest Department but belongs to Land Reform Commission to Forest Department. *(Already estimated budget - FD Rs.1 million)*	a) Identification of lands suitable for acquiring; b) Carry out relevant approvals for acquiring such lands under Forest Department; c) Annual evaluation on conservation improvements of acquired lands; d) Integrate REDD++ and eco-friendly practices and highlight benefits	a) Extent of land to be acquired; b) Documented progress on the outcome of the land transfer and incorporation of BMPs; c) Annual evaluation report on conservation value addition	FD	LRC, Ministry of Plantation Industries, Universities, REDD+ initiatives of SL	5	5	5	5	5	**25**
KRA 02-A10	Scientific improvement of pine plantation vegetation towards enhancing the quality of the under growth and cover type. *(Already estimated budget - Forest Department*	a) Assessing current status of vegetative cover in terms of improving undergrowth and converting pine to broad leaves; b) Develop a scientific approach an and investment strategy to operationalize the identified improvements;	a) Approach for under growth management developed and operational; b) Approach for converting pine to broad leaves; c) No. of pine plantations converted;	FD, ID and Universities	Land Reform Commission (LRC), Ministry of Plantation Industries, Private Sector, Universities, REDD+ initiatives of Sri Lanka	35	60	60	35	35	**225**

KRA No - Activity No.	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
	about Rs 200 million for 2016-2020)	c) Document the ecosystem improvement and socio-economic aspects of the change; d) Incorporate REDD++ concepts and climate change aspects for budget, when possible	d) Annual assessment and progress report on undergrowth management								
KRA 02-A11	Targeted land use planning and restoration of degraded and potentially degrading lands in upper catchment areas (E.g. Shifting crops, plantation management practices towards minimizing erosion and pollution as specified under soil conservation act and gazette 1894/3 - 22/12/14 source protection *(Already estimated budget LUPPD- Rs. 26 million for 2016-2020)*	a) Identification of degraded or sensitive lands that need restoration including land use pattern changes; b) Study the barriers for conservation and management and socio-economic impacts of land degradation and water quality deterioration; c) Formulate a plan with site specific recommendations based on soil/water/land conservation approaches to minimize impact of adverse cropping practices d) Implement a joint agency mechanism on prescribed land uses including the total conservation of selected (vulnerable) state lands; e) Develop and use a tracking and knowledge management system on site specific changes with time due to restoration	a) Demarcated sensitive or degraded lands in catchment areas; b) Identify drivers for land use changes ongoing; c) Mechanisms to minimize land degradation in place; d) Joint agency approach for optimal/prescribed land uses with a monitoring and knowledge management system	LUPPD, SD, Divisional Secretaries	FD, CEA, DWC, LRC, Ministry of Plantation Industries, TRI, RRI, Universities, District Secretaries, NWSDB, UNESCO, REDD++ initiatives	10	20	30	30	30	**120**
KRA 02-A12	Restoration of Degraded Hilltops *(Already estimated budget FD - Rs. 120 million for 2016 - 2020)* Note: This activity can be combined with a number of others in the implementation phase	a) Identification of degraded hilltops through a mapping and baseline survey; b) Replanting with appropriate plant varieties using proven conservation techniques; c) Establishing fire protection; d) Develop a tracking/ measurement system to evaluate the benefits of restoration covering both carbon and non-carbon benefits including soil	a) Restoration approach agreed; b) Planting and conservation plan developed; c) Progress tracking mechanism established; d) Annual assessment on multiple restoration benefits (about 250 ha)	FD	LRC, Ministry of Plantation Industries, Universities, Private Plantations, REDD+ initiatives of SL	10	30	40	50	50	**180**

KRA No - Activity No.	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
		enrichment and energy generation									
KRA 02-A13	Promotion of green business opportunities as alternate land uses - using special area characteristics based on nature and heritage (e.g.: white water rafting areas, heritage sites, historical sites, biodiversity hot spots)	a) Identify key geography regions or sites for targeted programme development or strengthening of existing enterprises using special eco system features, unique livelihoods, heritage etc.; b) Develop ecotourism and/or green products to add value to management and conservation of the basin (e.g.: alternative livelihoods); c) Eco-cultural events organized and promoted including the integration of national tourism promotions; d) Document case studies and develop promotional materials	a) Special Eco system, heritage and other featured areas identified; b) Special programmes developed and promoted; c) Promotional materials including case studies plus lessons learnt documented	NWSDB, CEA, Sri Lanka Tourism Development Authority (SLTDA), Private Sector operators	Ministry of Urban Planning and Water Supply, Ministry of Mahaweli Development and Environment, Ministry of Land, IUCN, Communities, Universities and local business	20	40	20	10	10	**100**
KRA 02-A14	Aligning with the proposed development projects and potential land use changes under the Western Region Megapolis planning	a) Review project information as they are available (e.g. investments on waste water, sewerage and other waste management, modification to roads, drainage, etc.); b) Incorporate the new developments into KRB plan as appropriate; c) Integrate reporting systems including financing modalities	a) Synchronized KRMP and Megapolis planning process; b) Identified investment opportunities through Megapolis; c) Integrated reporting systems	NWSDB, CEA, Ministry of Megapolis and Western Region Development	UDA, Ministry of Urban Planning and Water Supply, Universities	1	1	1	1	1	**5**

5.2.2. Management Objective B activity details

Industrial and Urban Management for Pollution Control and Sustainability

Objective: Improve the capacity to manage industrial environment systems and urban service delivery towards better pollution control, disaster preparedness and enforcement.

Expected outcome: Improve the capacity to manage industrial environment systems and urban service delivery towards better pollution control, disaster preparedness and enforcement

Key outcome indicator/s: Minimum of 75% of industries and Urban units participate in KRMP related pollution management and reducing threats to environment and human health

Issue/s: Industrial waste discharges, storm water and sewerage related pollution, deficiencies in emergency and preparedness to manage disasters/accident risks

Baseline data required: Industrial pollution related information, river pollution levels at different scales including tributaries, storm water, municipal waste and sewerage related information, extent of technology use, vulnerabilities, disasters/risks

KRA No Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
KRA 03-A1	Strengthening the CEA managed EPL process and its implementation *(Already estimated budget CEA -Rs. 5 million for 2016-2020)*	a) Updating EPL data base while reviewing the policy, institutional and operational gaps; b) Identification of potential improvements to EPL process at all levels; c) Develop a system of linking water quality monitoring to location of EPL holders; d) Operationalizing an improved EPL scheme along with improved dialogue among CEA, EPL holder and communities on water quality; e) Random site visits and monitoring by CEA and feedback to EPL holders and a compliance rating system adopted;	a) Improved EPL process in place; b) Enhanced dialogue among CEA, Community and EPL holder; c) Verification and validation of EPLs based on monitoring and inspection plus renewal scheme operationalized	CEA, Local Authorities, BOI	Ministry of Urban Development and Water Supply Ministry of Mahaweli Development and Environment, Ministry of Land, Universities, NCPC	5	6	3	3	3	**20**

KRA No Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
		f) Renewing/cancelling the EPL license based on performance									
KRA 03-A2	Improved approval process for new industries through the CEA circular 01/15 *(Already estimated budget CEA- Rs 1 million for 2016-2020)*	a) Developing guidelines for selecting industries based on basin land and natural resource uses and potential impacts; b) Site recommendation guidelines; c) Development of a system to monitor the adoption of pollution control measures during construction, commissioning and initial operation (e.g.: first year) for new industries; d) Develop support programmes such as training and awareness, monitoring and community relations for the new industrial projects	a) Mechanism to select appropriate industries to KRB in place; b) Monitoring and guiding process for environment management until fully operational including community interactions; c) Annual assessment report on implementing the circular no.01/15 available	CEA, BOI, NWSDB	Ministry of Land, LUPPD, Local Authorities, Communities, media	4	5	3	3	3	**18**
KRA 03-A3	Streamlining the environment management of industries (A, B, C categories) through EMS audits and promotion of investments on pollution control	a) Conducting an industrial (A, B, C categories) survey and compile EMS status related to pollution management and cleaner production; b) Investments on pollution management improved through cleaner production audits; c) Established a technical assistance programme at CEA with links to universities, technology providers and consultants to improve industrial pollution management	a) Improved industrial data base and EMS tracking system in place; b) Technical support scheme and a service provider database available; c) Demonstrated experience on communities involving in EMS near industrial sites; d) Annual review of the status of pollution control	CEA, BOI, NWSDB, Divisional Secretaries and Local Authorities	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, NCPC, Ministry of Megapolis and Urban Development	5	5	4	3	3	**20**
KRA 03-A4	Strict implementation of EIA provisions for mini hydro power establishment and operation *(Already estimated budget CEA*	a) Evaluate all possible adverse effects to environment by proposed, under construction or established mini hydros; b) Monitor the mitigation aspects when EIA is approved;	a) Annual assessment report on the environment considerations, mitigation actions and results	CEA, WRB, ID	SEA, NWSDB, ID	1	1	1	1	1	**5**

KRA No Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
	-Rs. 0.2 million for 2016-2020)	c) Annual review and reporting on the impacts and effectiveness of mitigatory measures									
KRA 03-A5	Evaluate and adopt suitable/proposed mechanisms to manage and control industrial discharges (e.g.: Polluter pay principle vs KRMP proposed partnership approach at tributary and sub-watershed level based on WSPs) and adopt a system most appropriate	a) Review pros and cons of load based permit scheme (EPL and Polluter Pays principle) to mitigate impacts of industrial discharges to water bodies with alternatives (WSPs or NWSDB proposed pipe for discharges up to a treatment facility); b) Compute social, economic and ecosystem values for alternatives and make recommendations; c) Refine the selected approach through pilots and develop policy, institutional and implementing arrangements; d) Introduce and monitor the new system. *Note: Indicated budget covers only the assessments/studies and investment will be computed within the assessment*	a) Pollution prevention schemes reviewed and additional information for decision making available; b) Socio, Economic, Policy and Operational gaps identified; c) Introduction of an agreed system to manage industrial discharges; d) Annual assessment of the progress of the implementation	CEA, BOI, Western Region Megapolis Ministry	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Universities Ministry of Land, Private sector companies/ agencies	8	1	1	1	1	**12**
KRA 03-A6	Improving capacities of Seethawaka and Biyagama waste water treatment plants *(Already estimated budget NWSDB- Rs. 228 million- 2016; Rs. 494 million- 2017; Rs. 38 million- 2018)*	a) Review the present status of Biyagama and Seethawaka waste water treatment plant operation; b) Make recommendations for technical, infrastructure and equipment related capacity improvements; c) Awareness and training towards implementing recommendations for key agency staff (NWSDB, CEA and BOI)	a) Plans to improve waste water treatment facilities; b) Enhanced capacity of treatment plants and staff; c) Increased awareness among managers, employees and users; d) Documented results of the strengthened capacities and mechanisms	NWSDB, BOI, CEA	Ministry of Urban Development and Water Supply, Private sector agencies/companies	230	500	40	20	20	**810**
KRA 03-A7	Establishment of a central treatment plant downstream of industrial areas (collection and pumping system along the river banks)	a) Assessing the current status of waste water generation, treatment efficiencies and issues; b) Review the proposal by NWSDB and WRMP to improve the waste collection and treatment;	a) Comprehensive information on options of waste water treatment and disposal available; b) Advocacy and financial material	NWSDB, BOI, WRMP and CEA	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment,	50	75	25	5	5	**160**

KRA No Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
	(Already estimated budget NWSDB - Rs. 30 million in 2016, Rs. 65 million in 2017 and Rs. 5 million in 2018.)	c) Making recommendations and promoting investment (preferably a pumping of waste all the way to a central treatment passing industrial areas; d) Justify financing of such facility considering the heath cost of pollution and other issues related to industrial discharges; e) Advocacy, training and awareness on implementing recommendations	available to promote investment; c) Economic assessments on the siting; d) Documented progress on establishing the proposed Central treatment		Ministry of Health, Govt. Treasury, Universities, IUCN						
KRA 03-A8	Minimizing the generation of shock loads to the NWSDB managed water treatment plants and rural water supply schemes *(Already estimated budget NWSDB- Rs. 90 million 2016; Rs. 195 million 2017; Rs. 15 million 2018)*	a) Assessing the current status of unusual loads to the water treatment plants; b) Identify causes and potential remedies (infrastructure, technology and awareness education); c) Design and implement a programme to address generation of shock loads including awareness and education	a) Recommendations to address generation of shock loads; b) Annual assessment report on the progress of managing shock loads to the water treatment plants maintain by NWSDB	CEA, NWSDB	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Ministry of Land	95	200	20	10	10	**335**
KRA 04-A1	Integrated solid waste management programme	a) Assessment of solid waste generation by local authority and minor-watershed levels; b) Develop integrated plans at local authority and minor-watershed levels to minimize the generation (reduce, recycle, reuse); c) Link the programmes with National level initiatives such as Pilisaru and Private Sector initiatives; and d) Promote technologies to use the solid waste (compost, biogas and soil enrichments; and e) Record the progress and lessons learnt plus promote study tours on best practices	a) Integrated plans to arrest solid waste issues; b) Additional income for communities; c) Reduction of health related issues (Dengue); d) Progress on proper management of solid waste	WP Solid Waste Management Authority, CEA, Local Authorities, Technology Providers	Ministry of Local Government, Ministry of Environment, Private Sector, Communities, Universities and Volunteers	300	300	300	200	200	**1,300**
KRA 04-A2	Streamlining waste, storm water and sewerage management in urban areas in KRB	a) Identify local authority areas with high storm water and sewerage issues; b) Evaluate options for recycle and reuse parts of the discharges (e.g.: biogas);	a) Information on waste and stormed water related information compiled towards	NWSDB, CEA, RDA, LAs	Ministry of Urban Development and Water Supply, Ministry of Mahaweli	240	510	40	10	10	**810**

KRA No Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
	(Already estimated budget NWSDB- Rs. 230 million- 2016, Rs. 38 million- 2018)	c) Estimate waste, storm water, sewerage amounts with locations along with capacities needed and finances including cost benefit analysis; d) Develop an investment and implementation plan including options identified; e) Implement a monitoring mechanism to refine the scheme and continue to promote alternative uses of discharges and potential use of wetlands	developing an investment plan; b) Clear option evaluation to recycle and reuse discharges and options for treating available; c) Targeted areas, technologies, responsible parties and finances identified; d) Implementation and annual assessment and progress on implementation and lessons learnt		Development and Environment, Ministry of Land, Ministry of Local Government and Provincial Councils						
KRA 04-A3	Promote greening in building constructions and urban planning by integration of waste, sewerage and rain water management systems into building design, spatial planning and approval processes	a) Evaluate options to green the urban planning and building construction processes (e.g.: biogas, rainwater harvesting, composting, 3R, 5R etc. and other BMPs; b) Develop guidelines and engage approval authorities, architects, planners and contractors; c) Motivate banks, financial institutions, local authorities, media and general public to adopt green concepts and advantages; d) Coordinate the adoption through KRMP and monitor the effectiveness of integration and document	a) Options to adopt green concepts and guidelines available; b) Capacity and awareness of relevant agencies and individuals enhanced; c) Adoption of green concepts monitored and lessons documented	LAs, UDA, National Chambers on Construction, Sri Lanka Green Building Council, Universities, Technical collagues	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Ministry of Land, Ministry of Local Government and Provincial Councils	20	20	20	15	15	**90**
KRA 05-A1	Developing preparedness capacity focusing on potential emergencies in industries, power plants, chemical storages, water treatment facilities and other key installations, including fire, chemical spills and	a) Reviewing present level of emergency preparedness; b) Identity policy, technology, institutional and resource gaps for meeting the emergency procedures for different emergencies; c) Identify key institutions and develop methodology/guidelines and preparedness plans;	a) Emergency preparedness plans for potential disaster/emergency types; b) Enhanced awareness and education on preparedness and actions;	DMC, CEA, NWSDB, Sector agencies, Local Authorities, Companies, Industries, General Public and Media	Ministry of Disaster Management. Disaster Management Centre(DMC), United Nations Children's Fund (UNICEF),	10	60	40	30	20	**160**

KRA No Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
	natural disaster induced emergencies	d) Establishment of a dedicated unit for industrial emergencies decentralized at industrial parks and key locations; e) Conducting related training and awareness programmes; f) Invest and operationalize the emergency preparedness plans and monitor and record the progress	c) Well-resourced emergency plan in place/practices; d) Policy and operational gaps identified addressed (e.g.: Fire units responding out of their jurisdiction)		WHO, UNIDO, IUCN, Universities Chemical weapons convention office of Ministry of Industrial Development						

5.2.3. Management Objective C activity details

Research, Studies, Awareness, Training and Education for Better Management and Conservation

Objective: Generate, share and use of scientific knowledge and best management practices to support Kelani River Basin Multi Stakeholder Engagement.

Expected outcome: Stakeholders groups are empowered with appropriate knowledge to successfully participate and adopt management and conservation practices

Key outcome indicator/s: Documented evidence to demonstrate that over 50% stakeholders are aware of the scientific aspects of management and conservation

Issue/s: Lack of scientific knowledge/evidence on pollution trends, environmental degradation and impacts, lack of targeted awareness and training, lack of advocacy opportunities to promote conservation

Baseline data required: Land use information, compute simulated scenarios, pollutant loads and causes, data related to ground water quality, pesticides, knowledge connecting issues, BMPs, and technologies, relationship of biodiversity, water users, communication strategies and effectiveness measurements

KRA No - Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
KRA 06-A1	Characterization of the ground water resources and improved management	a) WRB led detailed study of ground water resources; b) Compilation of added information on ground water (e.g.: studies on going with Universities etc.); c) Multi-stakeholder dialogue promoted to understand and evaluate threats and necessary management practices; d) Investment plans developed to protect and conservational use of ground water; e) Monitoring and reporting of ground water status, issues and recommendations based on findings	a) Ground water assessment completed for KRB; b) Priority recommendations to conserve Ground Water Resource identified; c) Multi-agency investment plan available to protect ground water	WRB, CEA and WRMP	CEA, NWSDB, IUCN, WHO, UNICEF, Ministry of Health, Universities	20	15	10	10	10	**65**
KRA 06-A2	Improved understanding of high level of ground water extractions, potential issues and adoption of an emergency pollution control approach around water intakes *(Already estimated budget WRB- Rs.12.5 million 2016, Rs.10 million 2017, Rs.2 million 2018-2020)*	a) Identify the intake points with high ground water extractions; b) Demarcate the area/zone of critical influence around each intake point; c) Develop a management strategy to arrest potential pollutant additions preferably through a partnership approach; d) Intensive monitoring of the quality of water in different intake locations and develop an information system combined with an early warning system on ground water quality and quantity	a) Location of high extraction points; b) Land use management approach to each zone/area of critical importance/influence c) Develop and adopt a public, private and community approach to manage potential pollutant additions; d) Information system for ground water monitoring network system available; e) Documented lessons and experience	WRB, CEA, NWSDB	BOI, Private Sector Companies relying on surface and ground Water, Universities	9	12	5	3	3	**32**
KRA 06-A3	Understanding the Environmentally Sensitive Areas (ESAs), Ecosystem Services and minimum E-Flows in KRB and mainstreaming Ecosystem Based thinking to KRMP as a value added approach including	a) Define the critical ecosystem services connected to water; b) Evaluate economic contributions by these eco system services (IUCN TEEBS); c) Identify and compute E-flows at selected locations (IWMI); d) Identify ESAs for ecosystem services and enhance the KRMP plan to mainstream ecosystem based concepts;	a) Identified important ESAs in the basin; b) Economic valuation of the Ecosystem Services focusing on water resources and biodiversity; c) Improved understanding of the sustainable levels of Ecosystem Services, E-flows etc. to be	Ministry of Mahaweli Development and Environment ,CEA, ID, LUPPD, SD, GAs.	Ministry of Urban Development and Water Supply, NWSDB, FD, SD, WD, BOI, IWMI, IUCN, UNDP, Universities, private sector agencies/companies	5	10	4	3	3	**25**

KRA No - Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
	climate change concerns on ecosystems	e) Evaluate the potential climate impacts for ESAs in the basin and promote adoption of BMPs; f) Training, capacity building, monitoring and reporting of the implementation of ecosystem based concepts along with KRMP progress and add the information to the content management system	maintained at different stream locations; d) Interpreted ecosystem services for decision making including land easements; e) Eco based approaches mainstreamed in the KRMP; f) River basin ecosystem monitoring and reporting system is in place								
KRA 06-A4	Evaluating the potential of using nature (e.g.: biodiversity), culture and heritage as a base to promote natural resource conservation and eco-friendly livelihoods	a) Detail nature and heritage assessment for Kelani River Basin; b) Identification of threatened species, heritage sites, threats to nature, culture and heritage and opportunities to make use the same for green business including ecotourism; c) Declare Environment Sensitive Areas and promote them as educational and exploration sites with minimum damages to ecosystems; d) Develop and implement investment and conservation plans to promote alternative livelihoods	a) Biodiversity, culture, heritage assessments available along with ESAS; b) Opportunities to green jobs and importance of critical areas and species documented; c) Plans for greener alternative livelihoods promoted; d) Implementation progress documented and used	FD, DWC, IUCN	CEA, LRC, LUPPD, SD, Local Authorizes, NGOs, Schools, Universities Banks, CBOs, Media	20	10	10	10	10	**60**
KRA 06-A5	Enhanced enabling environment for data sharing, modelling and computer simulation capacity of Kelani River Basin processes and ecosystems	a) Detail data collection/assembly on land use and landscape characteristics (LIDAR data on Colombo SLRDCC, upcoming Western Province to Survey Dept. by JICA and other relevant data); b) Identification of suitable modelling options; c) Formation of a multi-sector and multi-user group; d) Adopt a process to enhance compute simulating capacity to conduct what-if-scenarios to support Kelani River Basin management and conservation, help decision making on land uses,	a) Advanced capacity to visualize and simulate information; b) Integrated decision making ability combining economics, land use, social and ecosystem services; c) Opportunity to train university students and researchers; d) Case studies and publications; and	World Bank Climate Resilient Project, SLRDCC, LUPPD, CEA, Universities, UDA, IUCN	NPD, SD, Multi-lateral Banks, Bilateral Donors, Ministry of health, Department of Agriculture	10	10	10	10	10	**50**

KRA No - Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
		health, investment options etc. and to justify investments plus target resources.; e) documentation of lessons learnt and potential replications and international collaborations	e) International collaborations towards advanced training								
KRA 06-A6	Calibrating and validating a land use based simulation model/s to improve land use related decision making processes and research	a) Review the available models that can be used including Soil, Water Assessment Tool -SWAT by USDA; FLUX by US Army Corps of Engineers, Revised Universal Soil Loss Equation and applications; Surface modification related models, Drainage models, Crop models etc.; b) Revisit the data requirement and improve the data collection protocols, if necessary; c) Seek collaborations with Universities, Research entities local and abroad	a) Enhanced decision making capacity acquired through computer simulations and data processing: b) Decision support tools developed for multiple sectors; c) Awareness, education, and research supported; d) Student intern opportunities and joint research programmes facilitated	Universities, NWSDB, ID, GIS consortium, IESL, NRMC,	Ministry of Policy Planning; Ministry of Urban Development and Water Supply; research entities and media, IUCN	12	15	10	10	8	**55**
KRA 06-A7	Strengthening laboratory capacities of CEA and NWSDB for Environment Monitoring and information support for KRB Management and Conservation and replicate in other river basins *(Note: Current JICA project plans to assist in this)*	a) Assessment of laboratory, data management and other facilities; b) Capacity enhancement through equipment and training to support EPL and evaluate the impact of BMPs; c) Assess the use of facilities towards resource optimization and use	a) Enhance laboratory and information management capacity at CEA and NWSDB to facilitate EPL and impact of BMPs; b) Lessons learnt documented and initiative to replicate similar monitoring systems in other river basins	CEA, BOI, NWSDB	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Ministry of Land, JICA and IUCN	TBD	TBD	TBD	TBD	TBD	**TBD**
KRA 06-A8	Develop and implement a water safety planning approach at sub-basin, tributary or stream segment levels based on pollution sources	a) Sample each sub-watershed based on a design to understand the pollution sources for each tributary; b) Refine or develop a water quality assessment protocol to support KRB management and conservation that include seasonal, spatial and pollutant considerations;	a) Detailed water and other environmental variables sampling protocol and scheme established at basin, sub-basin and tributary levels; b) Data analysis and quality assurance system established;	CEA, NWSDB, NARA, CCD and Min. of Urban Development and Water Supply,	DA, ID, FD, DWC, World Bank, JICA, UNICEF, WRB, Universities, Research Institutes, Media, Schools, Communities	200	200	100	100	100	**700**

KRA No - Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
		c) Establish a joint agency system for grab sampling, real time monitoring and other data collection; d) Develop or improve facilities for sample analysis and quality assurance; e) Process and interpret the information to support Water Safety Planning (WSP) process and implementation through multi- stakeholder engagement	c) Capacity and methodologies of data interpretation in place; d) Information is being used for WSP; e) Documented progress of the Implementation	Private Sector							
KRA 07-A1	Comprehensive training and capacity development approach to support the implementation of the KRMP approach, strategy and action plan	a) Agency capacity assessment based on the KRB strategy and action plan; b) Identification of training needs by sector and agency (including convention focal points) along with potential sources of training; c) Development of a content or engagement system and training material to support the short, medium and long-term needs; d) Develop collaborations with River Basin initiatives around the world to share knowledge and learn; e) Implement training and record feedback	a) Capacity assessment available; b) Training material developed for different aspects; c) Current training programmes strengthened or new modules developed plus entry points or training institutions engaged; d) Continuous knowledge improvement on different subjects related to KRMP	CEA, NWSDB, IUCN, SLIDA, ICTA, Universities, Media	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Ministry of Land, UNICEF, WHO, Bilateral Donors	20	30	20	15	15	**100**
KRA 07-A2	Effective communication, knowledge delivery and advocacy support towards operationalizing the KRMP strategy and action plan	a) Strengthen the communication strategy on a continuous basis; b) Establishment of communication advisory task force; c) Establishment of a media forum; d) Implementation of communication activities through multi-media (print, social marketing, web based, advocacy, etc., also based on global literature on similar efforts); e) Conducting annual perception surveys and other evaluations as a feed back	a) Comprehensive communication plan; b) Adequate level of materials developed to support advocacy, education and awareness; c) Visible communication portals and resource pools; d) Social media and innovative methods adopted; e) Experience and reviews on communications on annual basis	CEA, NWSDB, LUPPD, IUCN	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Ministry of Land, UNICEF, WHO, Private Sector, Media, Environment Police, Universities, Bilateral donors	20	25	10	10	10	**75**

KRA No - Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
KRA 07-A3	Targeted capacity development for industries and others involved in Environmental Management System (EMS), ISO certifications, Global Reporting Initiative (GRI) related activities and benefits from adopting IFC performance standards	a) Review of standards, compliance and reporting related activities and entities who would benefit from targeted capacity developments; b) Identify links with capacity development effort with the implementation of the KRMP approach; c) Identification of trainers and target groups; d) CEA led standardization of training content; e) Use of EMS audits in KRB plan activities to target training and awareness; f) delivery and feedback	a) Identified opportunities and entry points to improve the compliance, reporting and EMS capacities; b) High quality trainings facilitated; c) Strengthened implementation of the KRMP approach; d) Documented progress and lessons learnt	CEA, Chambers of Commerce	Ministry of Industries, Private Sector, NCPC, EMS training institutions, Standard Institution, IFC, Banks, NWSDB, IUCN, Universities, World Bank and ADB	3	3	2	1	1	**10**
KRA 07-A4	Targeted training and awareness specific to Industrial Zones (IZs), industrial waste management facilities and water treatment installations. *(Already estimated budget NWSDB-Rs. 5 million for 2016-2020)*	a) Identification of targeted trainings; b) Establish certified courses and training options; c) Training activities based on audits and professional development needs; d) Evaluation on the progress and feedback	a) NWSDB capacity improvement; b) Training material for extended use; c) Annual assessment report on the progress of training and awareness programmes with a perception survey if appropriate	CEA, NWSDB	Ministry of Urban Development and Water Supply, Private Sector, Universities	1	1	1	1	1	**5**
KRA 07-A5	Training and awareness related to improving the capacities in the management of Municipal waste, storm water and sewerage as part of the KRMP implementation	a) Identify the specific training needs (part of the capacity assessment); b) Designing targeted trainings based on the analysis of the current status of municipal waste, storm water and sewerage management including technological options; c) Develop and implement a number of models (compost, biogas, rainwater harvesting etc.) as part of the training package; d) Identify trainers and conduct certified training to staff of the relevant institutions;	a) Enhanced capacity on waste, stormed water and sewerage management including environmental impacts; b) Long-term training mechanism in place; c) Pilot models to support training available; d) Annual evaluation with feedbacks	CEA, NWSDB, Local Authorities, IESL, SLRDCC, UDA	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Private sector agencies/ contractors	6	6	6	6	6	**30**

KRA No - Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
		e) Evaluate training effectiveness and improvements									
KRA 07-A6	Training and capacity development to support school related programmes in KRMP also highlighting health, water, environment linkages	a) Establish a school related training advisory group; b) Review of current status and delivery mechanisms related to school programmes in KRMP context including the Environment Pioneer Brigades (EPB) Programme of CEA; c) Identify relevant local and global educational models; d) Develop or strengthen current programmes and add new programmes; e) Multi-media material development especially using health and pollution linkages; f) Training of trainers and support to training at local levels; g) Engaging communities and private sector through training implementation; h) Evaluation of the progress, feedback and sharing lessons learnt; i) Annual recognition of school level champions in line with Environment Pioneers (EP)	a) Current delivery mechanisms related to school programmes identified; b) School programmes strengthened/developed c) Materials developed and trainers; d) Annual assessment on delivery and effectiveness of school programme/s with feedback	CEA, NWSDB, Ministry of Education, IUCN	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Ministry of Land, WRB, FD, SD, WD, ID, GAs, DSs, Private sector	5	10	10	10	10	**45**
KRA 07-A7	Training and awareness on gender perspectives in water/ environment management and conservation	a) Review and identify entry points and technical areas for gender mainstreaming in KRMP; b) Highlight gender perspectives in water/environment management and conservation; c) Training and awareness needs assessment; d) Identify opportunities and promote mainstreaming gender perspectives in project development, trainings and other events, including school level programmes; e) Material development to strengthen the interventions and conduct	a) Current school programmes that highlight gender perspectives in water/environment management and conservation; b) Broader level entry points and capacity development needs identified; c) Mechanism to conduct training and awareness programmes in place;	CEA, NWSDDB, Ministry of Women Affairs and Child Development	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Ministry of Land, Ministry of Education, Ministry of Social Services, WRB, FD, SD, WD, ID, GAs, DSs, private sector, NSF, SLAAS, Universities	1	1	1	1	1	**5**

KRA No - Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
		targeted training and awareness programmes; f) Annual evaluation with feedback and lessons learnt/case studies in incorporation or promoting gender perspectives in KRMP implementation	d) Annual evaluation with case studies/lessons learnt								
KRA 07-A8	Enhanced role of PHIs, DMOs, Provincial Health Director, Divisional Health Services Director and other health authorities towards education, awareness in KRB management and conservation	a) Summarize the current programmes and priorities relevant to KRMP; b) Consultations with key health staff (DG and Planning Directorate etc.) on the potential value additions at different scales of implementation; c) Develop material on health, environment, ecosystem etc. aspects; Awareness and education as needed; d) Find ways to support emergency preparedness planning; e) Progress monitoring and feed back	a) Value addition inputs by health service professionals to WSPs, awareness and preparedness; b) Material and guidelines available; c) Improved ability among stakeholder groups to articulate health, environment pollution and life quality linkages	Ministry of Health, CEA, NWSDB, Provincial Director of Health (Western, Sabaragamuwa, Central), IUCN	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Ministry of Land	10	10	10	10	10	**50**
KRA 07-A9	Student centred awareness and education participated by communities	a) Align the Environment Pioneer Brigades Programme of CEA towards the KRMP approach to provide students additional opportunities; b) Review other student centred educational programmes in the country such as NOAA GLOBE and private sector funded efforts; c) Develop a student centred hands on educational programme that include water aspects as well as related ecosystems; d) Seek public private partnerships to resource the programme; e) Investigate the possibility of student projects around the WSP and related implementation	a) Environment Pioneer Brigades Programme already in over 1,100 schools in the KRB strengthen; b) Value added student learning with equipment and participation in WSP; c) Demonstrated examples on how students can take the messages to communities; d) Private sector involvement enhanced for education and awareness	CEA, NWSDDB, Ministry of Education, IUCN, Biodiversity Sri Lanka	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment Services, WRB, FD, SD, WD, ID, GAs, DSs, Private sector, NSF, SLAAS, Universities	15	15	10	10	10	**60**

5.2.4. Management Objective D activity details

Operationalizing, Monitoring and Evaluation of the Kelani River Basin Management and Conservation Plan

Objective: Enabling environment and capacity to support stakeholder agencies and others to achieve KRMP goals ensured.

Expected outcome: Successful KRB management and conservation implementation model that can be replicated in other river basins

Key outcome indicator/s: More than 75% Govt. stakeholder agencies implement initiatives under the KRMP approach

Issue/s: Lack of a multi sector integrated approach for sustainable river basin management and pollution control, deteriorating land, river water quality and ecosystem values posing threats to humans and environment, unsustainable service delivery, minimal monitoring and evaluation capacity, lack of initiatives that link development initiatives in the basin with resilience, climate change and gender sensitivity

Baseline data required: KRB management and conservation plan, KRB related water quality data, gender segregated human resource data bases, stakeholder agencies involved with M & E, awareness and training on KRB management and conservation, multiple Govt. led mechanisms that can be made useful to coordinate/monitor activities such as the Pavithra Ganga Steering Committee; Committee on combating land degradation, Climate Change Advisory bodies for mitigation and adaptation, Advisory body on Invasive Species etc.)

KRA No - Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
KRA 08-A1	Establish an operational mechanism to coordinate the KRMP approach within the Government system which is flexible and efficient	a) Summarize potential operational mechanisms and high level consultations with relevant authorities (ongoing); b) Agreement on the structure of the management board, methods of handling finances and day to day coordination; c) Decide on the host institute, develop terms of references for key staff; d) Arrange for space equipment and necessary support services; e) Approvals for institutional and management structure and initial seed budget to commence the operation; f) Commencement of the formal KRMP implementation mechanism;	a) Key decisions on the Board, Coordination Mechanism and Financial handling; b) Roles and responsibilities of key staff identified and hired; c) KRMP approach operationalized; d) Review of the operation and improvements	CEA, NWSDB, IUCN	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Universities	50	40	40	40	40	**210**

KRA No - Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
		g) Annual reviews for potential improvements; h) Mechanisms for meeting administration costs and operational costs of the KRMP Secretariat									
KRA 08-A2	Comprehensive water quality and flow measurement system established to support sub basin and minor watershed level decision making	a) Validate the proposed monitoring mechanism with CEA, NWSDB and others for additional uses for research and modelling at sub watershed and main river; b) Establish minor watershed level flow and water quality monitoring to support TMDL approach of management of impaired watersheds; c) Purchase multi parameter probes and a number of systems for real time measurements of water levels and quality; d) Carryout capacity development (equipment and training) plus modelling capabilities; e) Establish a coordinated sampling and analytical protocol; e) Progress monitoring and reporting, annually and corrections, necessary	a) Enhance monitoring system for stream water quality in place; b) Larger involvement of research community and universities in data collection and interpretation; c) Data and information support to WSP process in place	CEA, NWSDB, ID, NRMC, CCD, NARA, JICA, IUCN	Ministry of Urban Development and Water Supply; Ministry of Mahaweli Development and Environment; ICTA, Universities, Media	20	20	20	20	20	**100**
KRA 08-A3	Integrating with National Air Quality management approaches	a) Review the air quality status of the Kelani River Basin using industrial emissions, vehicle emission testing programme related review status reports and UNREDD estimates from agriculture and land based emissions; b) Summarize the areas to be monitored and tracked in terms of Ariel depositions related to water quality; c) Integrate the air quality and water quality relationships into KRMP	a) Articulated connections between, air quality, health and water quality; b) Holistic approach towards industrial, vehicle and other emissions available in the KRB; c) Information made available for further research and development	CEA/AirMac, Department of Motor Traffic (VET programme), Universities	Ministry of Mahaweli Development and Environment, Ministry of Transport	3	1	1	1	1	**7**

KRA No - Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
KRA 08-A4	Develop and implement an operational support system for activity implementation, monitoring and evaluation	a) Develop and set up a content management system to collect, store, process and retrieve technical and management related information; b) Institutionalize Standard Operating Procedures (SOPs) specific to agencies to ensure the successful implementation of the KRB plan; c) Adopt a M & E mechanism to facilitate coordination and management decisions to implement and improve; d) Maintain a web page and document processes to meet reporting, resource mobilization, donor coordination, lessons learnt, etc.	a) Content management system in place; b) Communication and coordination systems in place; c) Technical, management and support staff trained and efficient in KRMP implementation, monitoring and coordination; d) Extensive and effective relationships with the partners	KRMP Secretariat, CEA, NWSDB, IUCN	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Ministry of Land and Universities	20	20	10	10	10	**70**
KRA 08-A5	Enhanced co-operation with Research and Development (R &D) entities and Universities to add value to KRMP approach	a) Summarization of past and ongoing R & D; b) Identification of research gaps and development of concept notes; c) Carry out limited modelling and visualization tasks to refine research concepts; d) Engagement of scientists (local and international) on relevant issues, solutions and future research; e) Administration of research grant facility	a) Modality to engage scientists and professionals in place; b) Grant scheme targeting research needs is operational; c) Engagement system to bring external knowledge via Sri Lankan expats in place	KRMP Secretariat, CEA, NWSDB, IUCN, Universities, NSF	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment	5	10	5	5	5	**30**
KRA 08-A6	Linking up with National Steering Committees for other key relevant initiatives to facilitate coordination and monitoring	a) Linking up with the national steering committees established for key national initiatives such as National Policy on Protection and Conservation of Water Sources, their Catchments and Reservations in by Ministry of Land and Land Development; Western Province Megapolis Plan Development and Implementation; National Steering Committee of "Pavithra Ganga Programme" and Steering Committee for Haritha (Green) Lanka strategy and Action Plan;	a) Strong links with national projects and programmes; b) Minimization of duplication and improving synergy plus cross fertilization; c) Potential joint reporting and educational and awareness; d) Demonstrated joint resource mobilization efforts	KRMP Secretariat	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, NWSDB, CEA and IUCN	1	1	1	1	1	**5**

KRA No - Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
		b) Coordination with the activities of a number of advisory committees and conventional focal points on Biodiversity, Land Degradation, Climate Change, Chemicals, Invasive Species etc.; c) Using the linkages to inform the progress of the KRB Management and Conservation Plan progress									
KRA 08-A7	Support to knowledge management, information and experience exchange and technology transfer	a) Operationalizing of a river basin knowledge hub that will support awareness, education, technology and experience sharing; b) Identify global and local best projects, pilots and practices; c) Develop exchange visits with other global programmes of similar kind; d) Use of multi-media and social media including websites and blogs to promote engagement.; e) Extension and sustainability of the Knowledge Portal through the National Pavithra Ganga programme	a) Comprehensive knowledge sharing platform available; b) Mechanism to promote global and local best practices; c) Enhanced engagement and interest generated via social media and multi-media tools	CEA, NWSDB, IUCN and KRMP Secretariat	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, JICA, Bilateral Donors, Universities	5	10	5	5	5	**30**
KRA 08-A8	Perception survey and multiple feedback mechanisms in place for improving and refining the technical and management of KRMP approach	a) Annual perception survey covering multiple stakeholder groups (state sector agencies, NGOs, CBOs, UN agencies, media, private sector, vulnerable communities, etc.); b) Use of web, blog and social media counts and response; c) Dedicated response mechanism established with staff and resources to address concerns and issues raised	a) Perception survey results; b) Other feed backs and responses to improve; c) Documented lessons learnt on feedback loops and value for improvements in the implementation modalities	CEA, NWSDB, IUCN	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Ministry of Land and Universities	2	2	2	2	2	**10**
KRA 08-A9	Basin wide celebration of selected international convention related events facilitated	a) Identify at least six international days to be celebrated in the basin (e.g.: Environment Day, Water Day, International Disaster Risk Reduction Day, Ozone Day, Volunteer Day etc.); b) Formation of a coordinating body and media sponsorships;	a) Improved organizing and coordinating capabilities and motivation of those involved in KRMP implementation; b) High visibility to programme work;	CEA, Youth Services Council, UN Volunteers, Private Sector	Universities, Schools, CBOs, Ministry of Mahaweli Development and Environment and Convention Relevant Ministries	6	6	6	6	6	**30**

KRA No - Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
		c) Organized events throughout the year (at least one in two months) to keep the visibility and momentum of KRMP implementation	c) Entry points to engage with senior policy makers								
KRA 08-A10	Establish a media forum to support the implementation of KRMP approach on conservation and management	a) Carryout discussions with leading media professionals on possible collaborations (advisory, volunteer, paid services etc.); b) Appoint an advisory group and agree on a series of interventions to promote concepts behind KRMP and the implementation; c) Carryout innovative activities including social media campaigns towards the objectives of KRMP; d) Mobilize resources through campaigns and social media for further activities	a) Enhanced visibility to the KRMP approach; b) Increased effectiveness of programmes (e.g.: advocacy, education, awareness etc.); c) Support towards implementation of emergency preparedness (to minimize industrial accidents and improve response)	Media agencies and professionals, CEA, NWSDB, Resource persons from different sectors	IUCN, Ministry of Urban Development and Water Supply, Private sector, Donor agencies and UN, Universities	5	5	5	5	5	**25**
KRA 08-A11	Engagement of key personal and volunteer coordination to improve the visibility and effectiveness of the participatory mechanisms of KRMP approach. (e.g.: leading politicians, recognized technocrats, celebrities etc.)	a) A system to mobilize the technical and management expertise of retirees as volunteers in different aspects of KRMP; b) Engagement mechanism to encourage youth volunteers; c) Coordinated system to receive and benefit from the active participation of political leadership, recognized figures in the society etc.; d) Mechanism to engage local expertise in combination of inputs from expatriates and international universities leading to long-term partnerships	a) Organized model systems to mobilize different types of personal and expertise; b) Mechanism to encourage youth volunteers; c) Documented evidence to demonstrate that over 50% stakeholders are aware of the scientific aspects of management and conservation Mechanism to promote local and foreign partnerships that also involve Sri Lanka scientists and academia; d) Annual evaluation on systems/ mechanism promoted with feed back	CEA, NWSDB, IUCN	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Ministry of Land, Ministry of Education, UN Volunteers, UNDP	3	3	3	3	3	**15**

KRA No - Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
KRA 09-A1	Enhanced gender sensitivity and disability concerns in KRMP activities while ensuring their specific needs (e.g. ensuring security for women travelling to distant places for monitoring, promotion of disable access to facilities and opportunities to engage)	a) Developing a gender and age segregated human resource data base covering all individuals in stakeholder agencies involved in KRMP activities; b) Established dedicated system to assess and provide for the needs of male and female officers in specific activities, including people with disabilities; c) Resources mobilization for special needs identified due to gender and disability concerns; d) Evaluation with feedback on lessons learnt including case studies	a) Gender segregated data bases; b) Special needs identified; c) Mobilized resources to address special needs; d) Lessons learnt and case studies	CEA, NWSDB, Ministry of Women's Affairs and Child Development	CEA, NWSDB, UNICEF, IUCN	3	2	1	1	1	**8**
KRA 09-A2	Mainstreaming climate sensitivity in programmes under KRMP	a) Assessment of climate impacts on basin eco systems, supported livelihoods and services such as drinking water; b) Develop value added or new activities on climate mitigation and adaption; c) Link KRMP with other national and regional programmes on mitigation or adaptation; d) Record of the value added effect of climate change mainstreaming in KRMP	a) Climate impact assessment; b) Value added activities based on mitigation and adaptation; c) Linkages with other projects and programmes d) Case studies	Climate Change Secretariat, CEA, NWSDB, REDD++	Ministry of Urban Development and Water Supply, Ministry of Land, Private sector, UNDP, WFP, FAO, IUCN	2	2	2	2	2	**10**

5.2.5. Management Objective E activity details:

Public Private Partnerships contributing towards the sustainability of Kelani River Environment

Objective: Improved private sector involvement in KRMP through staff participation, resources, technology and innovative partnerships.

Expected outcome: Deployment of sustainability concepts and CSR through partnerships with active participation by private sector

Key outcome indicator/s: At least 50% of the private sector entities located in the Kelani River basin are engaged positively in Public Private Partnerships in the KRB management and conservation

Issue/s: Lack of enabling environment for private sector, misunderstanding on the potential private sector contributions for ecosystem improvements beyond profits, sub optimal utilization of private sector capacity

Baseline data required: Water quality information at sub-watershed levels, BMPs and technologies, health and pollution relationships; investments by private sector within KRB

KRA No Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
KRA 10-A1	River basin free of hazardous waste - A public private partnership effort to collect and dispose hazardous waste expanding from current CEA and private sector efforts. *(Already estimated budget - CEA led M-waste and E-waste programmes by private sector)*	a) Evaluate the types and current level of collection and disposal of different hazardous waste types (e-waste, pesticides, stored materials, household hazardous material, industrial chemicals, radioactive materials, etc.; b) Develop a scheme or strengthen current efforts to ensure the KRB is hazardous waste free; c) Influence decision making and implementation of recommendations including the promotion of finances for required investments or partnership approaches; d) Implement and document the progress while highlighting the health aspects	a) Clear understanding of the current status of Hazardous waste generation, storage and management; b) A multi-stakeholder plan developed and implemented with the overarching goal of making the KRB hazardous waste free; 3) Enhance capacity and investments; c) Progress documented	CEA, Private Sector, NARA, BOI	DA, DAD, NWSDB, Registrar of Pesticide, IUCN, Ministry of Health, Universities	10	30	10	5	5	**60**

KRA No Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
KRA 10-A2	Private sector engagement in sub-watershed, tributary or stream segment level restoration and environment management in partnership with communities, schools and other voluntary groups (retired, local level CBOs, community groups, well-wishers, expats etc.) endorsed and participated by Govt. agencies	a) Participate in local level water quality monitoring efforts to understand the pollution sources; b) Support the local level WSP processes; b) Mobilize resources and staff towards implementation of WSPs including technology transfer (compost, biogas, rainwater harvesting or high end technologies) and promotion of BMPs on land uses; c) Innovative approaches and global experience transfer; d) Work with Govt. agencies and local authorities on improving service delivery efficiency; e) Take the lead in champion recognition at local level; f) Highlight the initiatives at local and international forums to improve visibility and replicability	a) Local level improved understanding of pollution sources; b) Documented innovative partnerships, investments and BMP implementation; c) Enhanced volunteerism and champions recognized at local levels; d) Improved service delivery documented; e) Private sector staff and resources mobilized; f) Lessons learnt highlighted	CEA, NWSDB, IUCN, UNDP, Chambers of Commerce	Govt. Ministries and agencies as appropriate, Local Authorities, UN Global Compact Companies, Private Sector, UN Volunteers, NGOs, CBOs., Universities, Media	20	20	20	20	20	**100**
KRA 10-A3	Development of a set of signature programmes that use the Public Private Partnership Modality	a) Review of potential opportunities through an advisory group formed with key private sector personalities; b) Develop a set of initiatives for the consideration of public sector agencies; c) Pay special focus on youth and volunteer participation and entry points; d) Formalize the partnerships through necessary MOUs; e) Add value through global partnerships, experience and participation in global events	a) A set of innovative PPP approaches; b) Enhanced opportunities for youth and volunteers; c) Innovative approaches and participation in local and global computations; d) Lessons learn and more programme development	CEA, NWSDB, IUCN, UNDP, Chambers of Commerce	Govt. Ministries and agencies as appropriate, Local Authorities, UN Global Compact Companies, Private Sector, UN Volunteers, NGOs, CBOs, Universities	2	2	2	2	2	**10**
KRA 10-A4	Promotion of emerging management concepts for enhanced sustainability and breakthrough thinking	a) Formation of a group of thinkers from Private, Public, Academia and others familiar and updated on emerging development concepts (e.g.: Blue Economy; Competitiveness; Human Development; Poverty and Disasters; Innovative ways to approach SDGs etc.); b) Facilitate the dialogues and work towards a policy forum on KRMP related issues	a) Platform to adopt emerging concepts and vision available; b) Increased interest of high level decision makers on Kelani River related issues and investment needs;	CEA, NWSDB, IUCN, Centre for Poverty Analysis (CEPA)	UN Agencies, Kadiragamar International Relations Institute, Institute of Policy Studies, Chamber of Commerce	3	3	3	3	3	**15**

KRA No Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
		and needs; c) Invite and engage high level decision makers and champions to facilitate new approaches to enhance the future sustainability of the KRB.	c) Innovative approach that can be shared/replicated								
KRA 10-A5	Recognition of champions (state sector agencies, NGOs, CBOs, private sector, Individuals, etc.) who significantly contributed to the KRMP approach	a) Annual recognition system developed; b) Potential sponsoring agencies identified and engaged (Government, private sector, media, etc.); c) Recognition events conducted with recognized panels and awards; d) Promotion of activities to get international recognition (e.g.: Students participating in Stockholm Junior Water Price)	a) Recognition systems developed; b) Operational mechanism in place for rewarding agencies; c) Enabling environment to extend the recognition to international is in place	CEA, NWSDB, IUCN, UNGC, UNV	Ministry of Urban Development and Water Supply, Ministry of Mahaweli Development and Environment, Bilateral, Multilateral and UN agencies	4	4	4	4	4	**20**
KRA 10-A6	Adopt a stream - a public- private - community partnership approach to manage and conserve stream segments or minor-watersheds (out of 71 minor watersheds in the basin)	a) Describe the pollution issues in 71 minor-watersheds b) Expression of Interests (EOI) and formation of minor watershed groups to include key local govt., public sector, industries, CBOs and voluntary groups who would like to be part of the management and conservation of the particular minor-watershed; c) Use WSP and other approaches as guided by the KRMP Secretariat to develop a set of action plans and implementation	a) Partnerships formed at local level; b) Clear vision to restore the minor watersheds; c) Monitor watershed based plans and implementing contributing to the overall goals of KRMP	NWSDB, Local Authorities, Private Sector	CEA, IUCN, Universities, Volunteer Groups, CBOs	10	15	15	12	12	**64**
KRA 10-A7	Voluntary indoor air quality promotion - Indoor Clean Air Initiative	a) Develop a protocol and a form a technical group from Private Sector companies to monitor the indoor air quality (Oxygen levels, light levels and other parameters contributing to indoor quality); b) Awareness and education and corrective actions such as disposal of waste kept indoors that are evaporating - chemicals, paints, electronics etc.; c) Monitoring the progress at sub-basin level with the objective of promoting air quality as a way to attract interest of public and others on general environment conservation and management	a) Enhanced involvement of private sector, public and others on environment issues; b) Improved heath aspects due to better indoor management including the scientific disposal of paints, electronic waste etc.; c) Overall improvements to the waste and environment management	Private sector voluntary groups; CEA, Holcim; NWSDB, Local Authorities	CEA, IUCN, Universities, Volunteer Groups, CBOs	3	3	3	3	3	**15**

KRA No Activity No	Activity	Sub activity/s	Output indicator/s	Main Responsible agency/s	Supporting agency/s	Timeframe with the estimated budget (Rs. Million)					Total Budget (Rs. Million)
						2016	2017	2018	2019	2020	
KRA 10-A8	Retail chains in action - A scheme to collect selected waste types for proper disposal	a) Collective agreement with retail chains (Cargill's, Keels, Luagh) on voluntary collection and scientific disposal; b) Engaging the disposal companies (e.g.: Geocycle, Phillips and others) to systematically collect and dispose; c) Review the finances of the process and develop a sustainable system of budget the process and monitor the progress and highlight the achievements. d) Promote the programme as a must initiative everyone	a) Practical mechanism to dispose non-degradable waste (laminations and other packing material) in place; b) Reduction of volume to municipal waste and segregation at voluntary level; c) Culture of recycling established	Retail chains; Schools, CBOs, Disposal Companies, Private Sector Sustainability Efforts; Producers of laminated material involved products	CEA, NWSDB, Banks,	12	12	10	10	10	**54**
KRA 10-A9	Kelani Kids - Introductory Environment	a) A private sector led programme that will involve kids at two age groups (5-8 years and 9 to 12 years); b) Develop outdoor activities for kids and parents around KRMP main activities (ex: Nature walks; story telling; awareness and education; games related to environment processes; movies etc.); c) Link resource groups from Universities and other environment NGOs - These could be linked up with minor-watershed programmes and up scaled time to time to sub-watershed level. This activity targets the employees and children of private sector companies.	a) Additional platform to engage communities; b) Enhanced interest on conservation and participation; c) Opportunity for company sustainability projects; d) Contributions to the overall KRMP goals	Private Sector Company Welfare and Sustainability Programmes, CBOs, Local Authorities	NWSDB, IUCN, Universities	3	3	3	3	3	**15**
KRA 10-A10	Upscaling the Environment Pioneer Brigade Programme with Private Sector Inputs - Sustainable Community Development and Nature Leadership	a) Design sustainable models that can be encouraged through the EPB programme of CEA (SADP - Ceylon Tobacco; Young Entrepreneurs; JCI, National Youth Programmes); b) Facilitate Private Sector management, coordination and inputs; c) Study tours to see different environments and issues; d) Promotion of species (fauna and flora) identification programmes;	a) Enhanced understanding and appreciation for ecosystems, plants and animals; b) Foundation for better scientists, researches and nature lovers; c) Beyond school desk to nature (regaining the lost cultures and knowledge)	IUCN, Private Sector, Universities, National Science Foundation, Relevant NGOs and research groups	Expatriates, Donors, Foundations and well wishers	6	10	10	10	10	**46**

Chapter 06: Water Quality Monitoring

6.1.Water quality monitoring approach

Kelani Basin Multi-Stakeholder Partnership (KRMP) activities at basin to minor-watershed level rely significantly on the water quality and stream flow measurements, among others.

Water quality is helpful to identify types of pollution and potential sources. For example, if the sediment levels are high in river water, it is an indication of agriculture or urban erosion issues whereas high E. coli levels indicate poor sanitation management including leaking toilets. Further, the heavy metals in streams are an indication of the need to focus on industrial discharges and electronic waste handling in the relevant drainage (watershed) area.

To get the overall understanding the water quality monitoring information needs to be supplemented by other ecosystem assessments such as biodiversity, changes in fauna and flora.

It should be recognized that extensive water quality monitoring is expensive. Hence a balance between cost and benefits while ensuring adequate quality information for regulatory, planning, awareness and education and policy formulation work is necessary.

In this chapter the current status of the water quality monitoring in the Kelani River Basin is reviewed and a comprehensive monitoring to support the management and conservation effort in KRB is proposed.

During the KRMP work it is proposed that the water quality measurements are accompanied by stream flow measurements at or near locations of the sampling sites, as much as possible to help in data analysis and estimation of pollution loads to support the TMDL approach (Chapter 4).

It is expected that the Government Agencies such as CEA, NWSDB, WRB, NARA, CC&CRM, ID and other Govt. agencies play a key role in monitoring information collection due to the technical nature of the work involved.

During the next stage of the KRMP approach (setting up phase) it is proposed to develop a series of guidelines to facilitate water quality monitoring including stream flow measurements with the support of agencies. These guidelines will help in the local or minor-watershed level measurements and planning work based on the water quality and stream flow monitoring.

The KRMP Secretariat proposed in Chapter 7 will work with key agencies to develop a system to share the water quality, stream flow, climate and other related data, in order to facilitate management and conservation efforts. Improved information delivery is expected to support education, awareness, training and research activities in the basin.

6.2.Value and use of water quality in estimating pollution loads

Load estimation of pollutants is one of the areas critical for decision-making. As presented in Chapter 1 using turbidity as an example and the Figure in this section using nitrate load as an example, knowledge of pollution loads allows us to decide on the extent of pollution reduction required in a

given watershed to meet the water quality criteria for watershed impairment and decide on the type of management practices to be adopted to achieve the target loading limits of the pollutant computed based on the TMDL approach

Normally the pollutant loads are computed by assessing the load of pollutants coming out of a sub-basin or a minor watershed by calculating the "Flow Weighted Mean Concentrations - FWMC" using flow and water quality data.

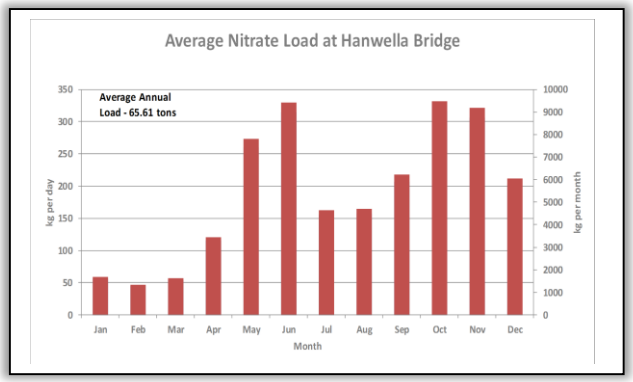

Figure 28: Pollution load estimation of nitrate nitrogen

The pollution load can be calculated on daily, monthly, or annually depending on the type and intensity of data available. For example, the water quality measurements carried out by CEA and NWSDB and the daily flow measurements by Irrigation department during October 2009 to September 2015 were used to estimate Nitrate – Nitrogen (from fertilizer and decomposition of organic matter in the environment) daily load passing by the Hanwella water quality monitoring location.

This finding helps to understand the nitrate loss from catchment/s upstream of Hanwella (over 65 tons per year on the average) and the seasonality of nitrate loss with June, October and November months the load exceeding 9 tons per month (Mallawatantri and Samarathunga (unpublished, 2016). Based on this information it is possible to decide on the management practices to reduce the load to an agreed target as described in figure 21.

Similarly, the pollutant loads can be computed for other parameters such as Phosphorus, Suspended Sediments, metals, E. coli etc., at basin, sub-basin and minor-watershed levels and used in the management strategies.

6.3. Seasonal variability

The pollution loading (FWMC multiplied by concentration) depends on the stream flow as a result of prevailing rainfall conditions.

For example, in Hanwella, the months of January to March can be low-flow months and May-June and October-November can be high flow periods. These high and low flow periods may vary in certain years so adjustments have to be made when decisions on sampling days. The present and the proposed expansions (more locations and different time intervals) of these monitoring have considered these seasonal variations.

On the other hand, with improved management practices, it may be possible to reduce the load of pollutants, while maintaining the same flow volumes. For example, the buffer strips or constructed wetlands can minimize sediment and other nutrient additions including metals. In such situations, monitoring and load estimations will allow us to evaluate the effectiveness of the management practices adopted during the implementation phase.

Community or student assistance can be used for measuring daily flow level (reading the gauging stations). Calibration or the establishment of a relationship between water level and flow volume

in each monitoring site can be completed with the support of universities and Government agencies.

6.4.Water quality standards

Both CEA and NWSDB follow American Public Health Association (APHA) standards including water quality monitoring. As such, the KRMP approach also adopted United States Environment Protection Agency (USEPA) derived water quality guidelines and management approaches, as much as possible.

The industrial discharges of wastewater are regulated by the Environmental Protection Licenses (EPL) of CEA under the provisions of the section 23 (a) of the National Environmental Act of 1980. The discharges may be organic including sewerage or inorganic including heavy metals. The EPL stipulates that industries treat wastewater up to a relevant standard given in the EPL prior to discharging into the environment (Annexures for different industrial discharges). Municipalities and non-point source discharges are not covered in EPL context and need to be addressed differently but, can be guided by the standards set for storm water discharges.

Irrigation Department, Water Resources Board (WRB), National Water Supply and Drainage Board (NWSDB), Central Environment Authority (CEA), Board of Investment (BOI), National Aquatic Resources Agency (NARA), Mahaweli Authority of Sri Lanka (MASL) and Coast Conservation and Coastal Resource Management Department (CCD) are involved directly and indirectly in managing water, collecting data and formulation of policy, guidance including standards to protect the basin ecosystem.

6.5.Water Quality Index (WQI)

CEA developed a Water Quality Index (WQI) that describes the relative status of water quality among different monitoring locations. It uses the water quality parameter measurements and the trend in water quality change in a given location.

The WQI approach combined with pollution load estimates modelling and TMDL calculations can be used to explain the status and trends of water quality at sub-basin and minor-watershed levels to help in the planning and implementation of management and conservation practices in the basin, sub-basins and minor-watersheds.

6.6.Existing monitoring system

Regular monitoring of water quality is carried out by NWSDB and CEA in 13 locations since 2003. The NWSDB and CEA coordinate the sampling times and ensure that sampling dates are arranged to match a monthly sampling pattern. In addition, the Irrigation Department is monitoring the stream flow at a number of locations in the KRB.

Flow monitoring by Irrigation Department is done at selected locations. Expansion of these locations is resource intensive, yet as highlighted earlier having a flow measurement along with a concentration measurement increase the value of the monitoring, significantly and needs to be seriously considered as positive investments for the future.

However, when the minor-watershed level water quality and water flow measurements are taken under this Strategy and Action plan implementation, a simplified mechanism for measuring stream water flow need to be designed with the support of literature and technical assistance from the Irrigation Department and Universities.

These stations may have less depth so communities should be able to manage them with proper guidance and training.

The CEA and NWSDB led bi-weekly sampling process currently measure pH, Electrical Conductivity (EC), Turbidity (NTU), Temperature, Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Phosphate, Nitrate, Chloride, dissolved Lead (Pb), dissolved Chromium (Cr), Total Coliform and Faecal Coliform (E. coli).

The NWSDB also monitor industrial wastewater discharges at downstream canals from "Seethawaka" and "Biyagama" Industrial Zones. In Seethawaka pH, DO and colour are checked daily and TSS, BOD & COD weekly while in Biyagama TSS, BOD, COD & pH are checked on a monthly basis.

At present Biyagama and Ambathale water treatment plants have online analysis of water quality parameters such as pH, Turbidity, Dissolved Oxygen, Conductivity and RCL. Heavy metal analysis is being carried out bi-weekly for Ambathale and the other places once a month.

Table 20: Irrigation Department flow monitoring

River Gauging Stations	
No	Location Name
QLP1	Nagalagam Street
QLP2	Hanwella
QLP3	Glencourse
QLP4	Deraniyagala
QLP5	Kitulgala
QLP6	Norwood
QLP7	Holombuwa

Table 21: CEA and NWSDB monthly monitoring stations

SN	Relevant NWSDB water intake point	Sampling Location of NWSDB	Sampling Location CEA
L1	Nallatanniya- Seetagangula	Victoria bridge	Japanese friendship bridge
L2	Yatiyantota - Wee Oya	Raggahawatte Ela (Tributary)	Raggahawatte Ela (Tributary)
L3	Morontota- Gurugoda Oya	Maha Ela (Tributary)	Maha Ela (Tributary)
L4	Gonagaldeniya- Nagas Ella	Pusseli Oya (Tributary)	Pusseli Oya (Tributary)
L5	Kannantta- Hallolu Oya	Hanwella Bridge	Hanwella Bridge
L6	Ruwanwella- Kelani River	Pugoda Ela (Tributary)	Pugoda Ela (Tributary)
L7	Dehiovita- Maha Oya	Pugoda Ferry	Pugoda Ferry
L8	Bulathkoupitiya- Adurapola Ela	Wak Oya (Tributary)	Wak Oya (Tributary)
L9	Avissawella- Seetawaka River	Seethawaka Ferry	Seethawaka Ferry
L10	Seetawakapura- Kelani River	Thalduwa Bridge	Thalduwa Bridge
L11	Poogoda- Kelani River	Kaduwela bridge	Kaduwela bridge
L12	Ambatale- Kelani River	Welivita	Welivita
L13	Biyagama(KRB)- Kelani River	Ambatale Intake	

6.7. Review of the water quality monitoring capacity

The water quality monitoring carried out by CEA and NWSDB had been commendable given the resource limitations the two agencies had for this purpose. Both institutions have trained and dedicated staff who really value the potential contribution of water quality data towards management and conservation decisions of the KRB and to ensure good source water for drinking and other purposes.

While appreciating the initiatives taken so far, the following gap analysis conducted identifies a number of areas where additional investments, policy changes and capacities to be developed to establish a robust monitoring system capable of supporting effective management and conservation of the Kelani River Basin as envisaged in the KRMP approach. JICA at present has fielded a team, base at CEA to further evaluate the potential system improvements in this regard.

6.8. Potential improvements and recommendations

Based on the past experience of data collection by CEA, NWSDB and ID a number of observations were compiled to be used in future planning. While recognizing the dedication of the three agencies to collect information under resource constraints, the observations are presented below in the forms of Gaps and Recommendations.

Gap 1: Inadequate water and flow monitoring stations to meet the KRMP implementation. The present sampling only covers part of the river basin.

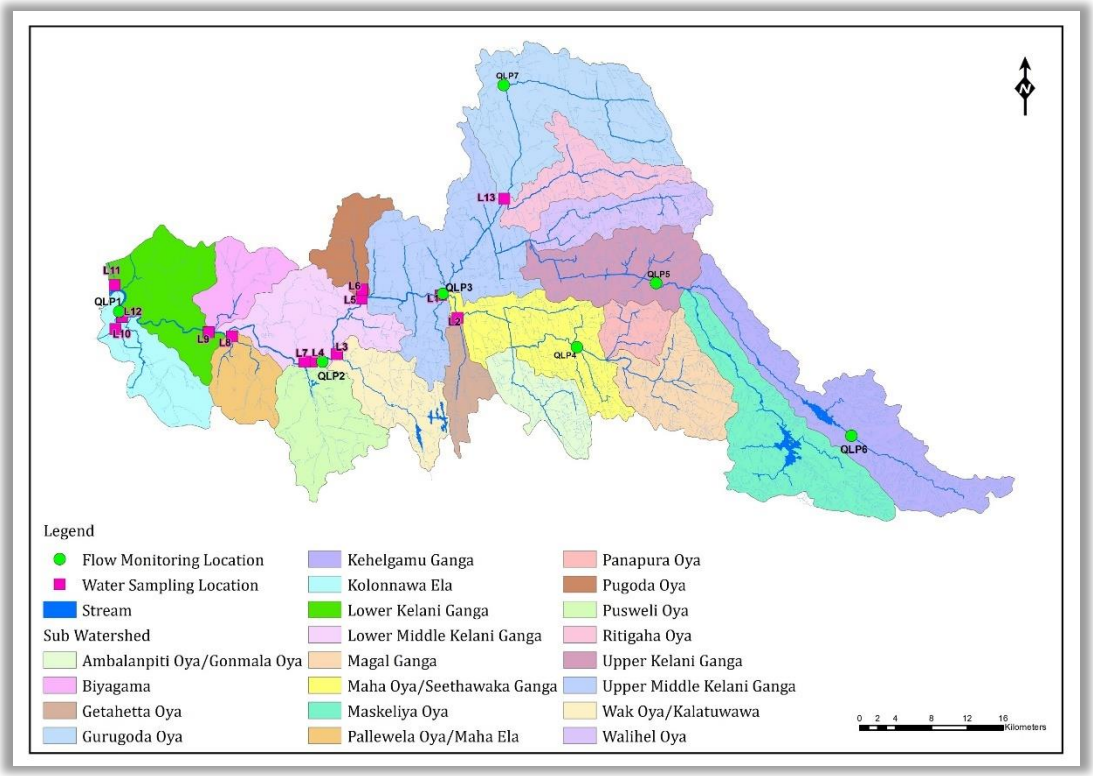

Figure 29: Current water quality and flow monitoring locations

Source: NWSDB & Department of Irrigation

Recommendation 1: Current 13 stations sampled by CEA and NWSDB were meant to cover the industrial pollution. With increasing land use changes including the urban expansion this coverage may need to be expanded both in terms of water quality and flow in the main river.

This requires a mechanism to expand the water quality monitoring sites, a funding mechanism, staff and analytical capacities including sampling. In addition, a mechanism to compute daily flow at each monitoring station is needed.

It may be possible to use real time monitoring for a set of selected parameters provided the stations can be secured and resources can be allocated. The envisaged minor-watershed level work may significantly increase the number of monitoring sites too.

Gap 2: Water quality monitoring coverage on metals, microbial counts, chlorophyll and radioactive material in the environment is inadequate to support a comprehensive pollution management effort as confirmed by (CEJ, 2015).

Recommendation 2: With industrial and urban expansions the volume and types of waste may also increase/vary. In addition, the complexities associated with waste disposal will pose challenges too.

New waste types may include electronic, sewerage, hazardous, radioactive material, high level nutrients additions enhancing algal activities etc. Hence the need exists to expand the types of contaminations to be monitored.

In order to implement this recommendation, it is necessary to add resources as well as expand the sampling and analytical capabilities. This additional capacity may help during emergencies to identify pollutions and take necessary steps to contain, diffuse or handle the chemicals and other pollutants.

Gap 3: Spatial resolution of monitoring data may not allow for "source identification" at sub-basin or minor-watershed levels

Recommendation 3: The pollution types may vary among sub or minor watersheds and understanding the "sources" at local level may help to device management practices to reduce the pollution and to decide on type of interventions and investments at local levels.

As such it is recommended to monitor the quality or the health of the minor watersheds using a protocol beyond the current practices of covering the main river in selected locations. It is envisaged that about 150 water quality samples are needed every year to characterize the stream water quality of 71 minor watersheds in the basin.

Gap 4: Access of data to support the management and conservation efforts, including the water quality and stream flow data are not optimal.

Recommendation 4: In most instances the researchers and public has to pay for data generated using public funds by state agencies. For example, data collected by CEA, Irrigation Department, Meteorology Department are not accessible readily, sometimes even after paying. While promoting the concept of National Data Exchange being considered in the country, it is proposed to establish a basin wide data storage and retrieval system as part of the content management system suggested under the KRMP Secretariat. The USEPA STORET system is a good example to follow.

Gap 5: Ecological monitoring to strengthen and complement water quality monitoring is not available.

Recommendation 5: Information on water quality alone is not adequate to track the quality and strength of ecosystem services in the Kelani River Basin connected to humans as well as to

fauna and flora. Industry, urban expansions and man-made influences including climate change and ariel depositions of pollutants impact the ecosystem health. In addition, to monitor the impacts of dams and impoundments (eg. Major and Mini-hydro power stations), it is necessary to monitor the ecosystems.

It is proposed to adopt a concurrent ecosystem based monitoring covering key ecosystem parameters beyond water to include parameters covering air quality, soil quality, river mixing characteristics, benthic populations, land and stream based fauna and flora etc. It will help to interpret the results of conservation efforts better.

This aspect could be mainstreamed into university and community learning with the support of scientists from relevant fields.

Gap 6: Ground water quality and quantity tracking system is not available

Recommendation 6: Some ground water data related to Kelani River Basin is available through WRB and a number university studies (CEJ, 2015). However, the completeness and the coverage can be improved. It is proposed to empower and build the necessary capacity at WRB to compile and follow up on a benchmark dataset (every three years?) that may potentially cover nitrates, Sb, Asbestos, As, Ba, Be, Cd, Cr, Cu, CN, F, Pb, Hg, NO_2, Se and Tl) and organic chemicals including several pesticides, PCBs, PAHs, phthalates and volatile hydrocarbons, and radionuclides (alpha and beta particles, Ra 226 and 228 and Uranium. Note: This list adopted from USA may be narrowed down or modified considering the potential pollutants in the Kelani River Basin.

6.9. Proposed enhancements for monitoring

An enhanced monitoring system is proposed taking advantage of the already operating sites by CEA and NWSDB and extending the design upstream to cover the entire basin.

A number of new parameters have been proposed to all sites and an additional four sites have been added in the lower part of the basin for a better coverage. These station locations can be further refined based on the needs. In addition to monitoring of the main river which will provide the pollution level of 20 sub-watersheds.

A separate set of monitoring data needs to be generated and maintained to support the planning and management of 71 minor watersheds.

Objectives of the water quality monitoring programme is to:

1. Provide a comprehensive “baseline” for the Kelani River Basin at basin, sub-basin and minor-watershed levels that will transform into a “trend” monitoring effort during KRMP implementation.
2. Serve as a “compliance” and “effectiveness” support monitoring tool to facilitate the implementation of the Kelani River Basin management and conservation efforts.
3. Strengthen the education, awareness and training of agencies, communities, students and others.

The proposed water quality and flow monitoring in the **main river (1 and 2)** and **minor-watersheds (3)** will involve five types of monitoring.

1. An expansion of the present bi-weekly monitoring with enhanced sites (map below) using a limited set of parameters along with a

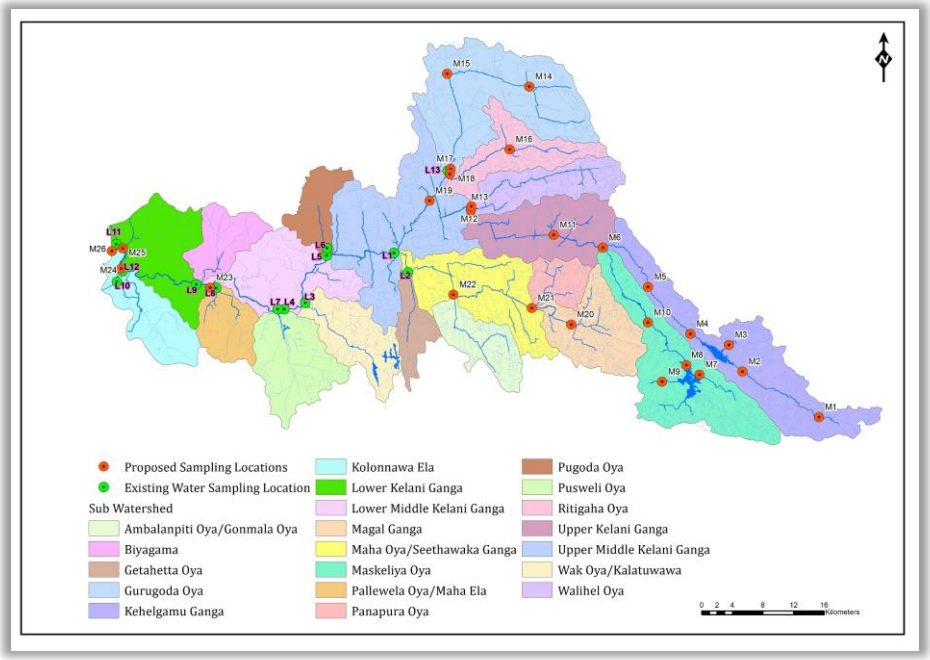

Figure 30: Proposed Water Sampling Stations

mechanism to estimate **daily** stream flow. This will strengthen the long-term monitoring and the implementation of CEA WQI concept and allow for load based assessment out of sub-basins and critical locations in the main river.

The same data may help to calibrate and validate land use based computer simulation models. The bi-weekly monitoring will also account for the high variation in the flow and concentrations due to floods, storms and other seasonal variations including areal depositions, climate induced variations etc. *Note: A few strategic locations can be selected for pesticides analysis based on the cultivation season and other concerns. However, the extensive dilution of pesticides in water may pose a challenge for analysis as the current detection limits for pesticides are higher than the pollutant concentrations in water.*

2. Quarterly monitoring of the above selected sites for an **additional set of parameters** as outlined in the Table below. This monitoring is proposed to assess the status of water quality coming out of each 20 sub-basins and include parameters covering heavy metals and other parameters that are expensive to measure on a bi-weekly basis.

3. Basin wide six month (seasonal) sampling covering the streams in minor-watersheds to support "source identification" that cover high flow and low flow periods. This sampling may use a limited set of parameters specific to the conditions in the minor-watershed (initial year of blanket sampling to understand the minor-watershed pollution pattern and narrowing down of pollutants to monitor starting from second year). This will allow the identification of sources of pollution prevailing at each sub-watershed or tributary segment and help in the minor-watershed level planning (in line with Water Safety Planning) to manage point and non-point source pollutions at local level.

4. **Site or event specific** water quality measurements mostly as a disaster preparedness or response measure or to support targeted studies and research. This is a very specific area of monitoring but the information gathered may add value to the programme, significantly. For example, the past and ongoing research at Universities may fall under this category, among other investigative research.

5. Monitoring data through voluntary monitoring and other school programmes that are part of the awareness, education and training. This type of monitoring may use less sophisticated techniques and low-end equipment (e.g.: Jalthara for water and Pavanthra for air developed by Centre of Environment Studies in India). Although the quality of this source of information is not at the same level of agency led/guided efforts the large volumes of data collected via this process may provide a statistical validity (principle used by NOAA programme on Global Learning and Observation for the Benefit of Environment – GLOBE). Sri Lanka is a signatory to GLOBE via CEA and Ministry of Education.

6.10. New sampling scheme proposed

The new scheme proposed to track changes in the main river is expected to support the KRMP implementation. It will also help to evaluate the impact of the local level activities based on the type of "pollution source" using the 71 minor-watershed approach.

The monitoring proposed below is focused on the main river and its main tributaries. The sampling locations needs to be fine-tuned at the start of the implementation considering the relationship of the proposed monitoring sites to minor-watershed monitoring sites. Practical aspects of obtaining or setting up of sites for daily flow measurements at a nearby location/s to do a reasonably good job in load estimation is also a key deciding factor for setting up of the monitoring stations.

In addition, the proposed plan has covered the location above Avissawella. The current monitoring focuses on Avissawella (Seethawaka Industrial Park) and below. It is proposed that, initially, the new sites up steam of Avissawella be monitored monthly while the old sites maintain a bi-weekly frequency.

Table 22: Proposed sampling scheme and standards

Parameter	Bi-weekly current plan	Bi-weekly proposed	Monthly coverage	Low Flow	High Flow	USEPA MCL (mg/L)	WHO Health (mg/L)	Discharge Std. Sri Lanka (mg/L)	Drinking Std. Sri Lanka (mg/L)	Inland Surface Sri Lanka Std. (mg/L)
Temperature C.	L	L	L and M	L and M	L and M			40		
pH	L	L	L and M	L and M	L and M			6.0-8.5	6.0-9.0	6.0 to 9.0
Electrical Conductivity (EC)	L	L	L and M	L and M	L and M					
Dissolved Oxygen (DO)	L	L	L and M	L and M	L and M				4	4
Turbidity	L	L	L and M	L and M	L and M					
Biological Oxygen Demand (BOD)	L	L	L and M	L and M	L and M	200	5	5		
Chemical Oxy. Demand (COD)	L	L	L and M	L and M	L and M			600		
Total Organic Carbon (TOC)		L	L and M	L and M	L and M					
Total Dissolved Solid (TDS)		L	L and M	L and M	L and M					
Alkalinity		L	L and M	L and M	L and M					
Total hardness		L	L and M	L and M	L and M					
Calcium			L and M	L and M	L and M	0.04	0.005			
Magnesium			L and M	L and M	L and M					150
N-Nitrate	L	L	L and M	L and M	L and M		50		10	10
N-Nitrite		L	L and M	L and M	L and M		50			
N-Ammonia		L	L and M	L and M	L and M			50		0.06
Total N		L	L and M	L and M	L and M					
N-Nitrate	L	L	L and M	L and M	L and M		50		10	10
Chloride	L	L	L and M	L and M	L and M		250	900	1,200	
Sulphates		L	L and M	L and M	L and M		500	1000		
Ortho Phosphate		L	L and M	L and M	L and M					
Total phosphosphate (TP)		L	L and M	L and M	L and M					
Fluoride		L	L and M	L and M	L and M	4	1.5		1.5	
Chlorophyll -A		L	L and M	L and M	L and M					
Aluminium				L and M	L and M					
Arsenic				L and M	L and M	0.01	0.01	0.2	0.05	0.05
Boron				L and M	L and M		0.3	2		
Cadmium				L and M	L and M	0.005	0.003			
Chromium	L	L	L and M	L and M	L and M	0.1	0.05	2	0.05	0.05
Copper				L and M	L and M	1.3	2	3		1.5
Cyanide				L and M	L and M	0.2	0.07	0.2	0.05	0.05
Iron				L and M	L and M					

Parameter	Bi-weekly current plan	Bi-weekly proposed	Monthly coverage	Low Flow	High Flow	USEPA MCL (mg/L)	WHO Health (mg/L)	Discharge Std. Sri Lanka (mg/L)	Drinking Std. Sri Lanka (mg/L)	Inland Surface Sri Lanka Std. (mg/L)
Lead	L	L	L and M	L and M	L and M	0.015	0.01	1	0.1	0.1
Manganese		L	L and M	L and M	L and M		0.5		0.001	0.5
Mercury		L	L and M	L and M	L and M	0.002	0.001	0.001		0.001
Selenium		L	L and M	L and M	L and M	0.05	0.01		0.05	0.05
Silver		L	L and M	L and M	L and M					
Sodium				L and M	L and M					
Xylene				L and M	L and M	10	0.5			
Zinc				L and M	L and M		3	10		
Oil and grease		L	L and M	L and M	L and M			30	10	0.1
PCBs				L and M	L and M					
Phenolic Compounds				L and M	L and M			5	0.005	0.005
Tetrachloro Ethylene				L and M	L and M		0.07			
Carbon Tetra Chloride				L and M	L and M	0.005	0.002			
Vinyl Chloride				L and M	L and M	0.002				
Pesticide				L and M	L and M					
Total Coliform	L	L	L and M	L and M	L and M					
Fecal Coliform	L	L	L and M	L and M	L and M				5000	

Key for sampling sites

L		Old sampling sites
L	Old sampling sites with added parameters	
L and M		Old and New sites to be measured on monthly (note: only M are to be added to the bi-weekly new sampling scheme
L and M		All sites sampled at low flow, once a year
L and M		All sites sampled at high flow, once a year

The location description of existing (L) and newly added water quality sampling sites (M) are provided below. Further discussion is needed with the Irrigation Department to select the sites to get the stream flow relevant to the new sites added and for some of the old sites while the locations need to be validated with CEA and NWSDB observations.

Table 23: Existing and proposed water quality monitoring stations

No	Name	WGS 84		Ref. No	Description
		Longitude	Latitude		
1	Hambantota Oya at Galaboda	80.706836	6.782794	M1	One of the starting points of Kelani River with small streams originating from natural forest area & tea lands
2	Kehelgamu Oya at Norwood	80.612269	6.839586	M2	River passes two small towns of Bogawanthalawa & Norwood
3	Dikoya Closer to Castleriegh Reservoir	80.604118	6.873558	M3	Drainage from Dikoya town & tea plantations
4	Kehelgamu Oya Below Castlereagh Reservoir	80.561475	6.875985	M4	Water after retention in Castlereagh Reservoir connected with a number of small streams
5	Kehelgamu Oya at Kalaweldeniya (Norton)	80.503852	6.936752	M5	Water after retention in Norton Reservoir connected with a number of small streams
6	Kelani River at Polpitiya	80.449748	6.982916	M6	Confluence of Maskeliya Oya (after passing three dams of Maussakeliya Reservoir, Canyon & Laxapana) and Kehelgamu Oya passing Castlereagh and Norton Reservoirs.
7	Maskeliya Oya Closer to Maskeliya Town	80.573347	6.828259	M7	Drainage from tea plantations being added
8	Below Maussakele Reservoir	80.548694	6.843836	M8	Water after retention in Maussakele Reservoir
9	Sitha Gangula at Nallathanniya	80.527209	6.824527	M9	Water from Adam's peak forest area with pristine quality
10	Maskeliya Oya at Laxapanagalla	80.509168	6.891223	M10	After retention in Maussakele Reservoir with a number of streams from forest areas & tea lands added
11	Kelani River at Kitulgala	80.386898	6.998722	M11	Kelani river after Kithulgala town & residential areas with major tributaries added after M6
12	Kelani River at Yatiyanthota	80.293119	7.031536	M12	After a number of towns, tea lands & high density residential areas
13	Welihel Oya at Yatiyanthota	80.293811	7.032687	M13	Water from forested areas, tea areas & residential areas
14	Alapolawala Oya at Morantota	80.361912	7.17423	M14	Water comes from passing tea lands home gardens & retaining at several mini hydropower dams
15	Gurugoda Oya at Boyagoda	80.266068	7.189114	M15	After paddy lands, tea lands and home gardens
16	Ritihaha Oya Bulathkohupitiya	80.337731	7.099954	M16	After paddy lands, tea lands and home gardens
17	Gurugoda Oya at Kannattota	80.270682	7.07708	M17	After paddy lands, tea lands and home gardens plus a number of urban areas
18	Ritigaha Oya at Kannattota	80.268679	7.072437	M18	After more paddy lands, tea lands, home gardens and several town areas

	Location	Longitude	Latitude	Ref. No	Description
19	Kelani River at Kananttota	80.26767	7.074487	L13	Confluence of Gurugoda Oya and Ritigaha Oya
20	Kelani River at Ruwanwella	80.245145	7.03856	M19	After paddy and tea lands, home gardens and urban areas
21	Mogal Ganga at Pallepansiya	80.412565	6.892161	M20	After forest area (Adam's peak) and passing tea lands, home lands & paddy areas
22	Sithawaka Ganga at Ihala Nakkawita	80.368641	6.911946	M21	Addition of more streams and passing several small towns
23	Sitawaka ganga at Yogama	80.274254	6.925329	M22	Addition of more streams and passing several small towns
24	Sithawaka Ganga Closer to Avissawella	80.2201	6.953958	L2	Sithawaka Ganga before Kelani River
25	Kelani River, Kudagama Thotupola	80.202952	6.977031	L1	After joining Kelani River & Sitawaka Ganga
26	Pugoda Oya at Radawana	80.123687	6.982546	L6	After paddy areas & home gardens
27	Kelani River at Pugoda	80.123397	6.973376	L5	After Avissawella town and Sithawaka industrial zone
28	Wak Oya Closer to Hanwella	80.098323	6.917511	L3	Water from Labugama, Kalatuwawa areas and after passing paddy lands
29	Kelani River at Hanwella	80.074111	6.908205	L4	Water after several major towns and industrial areas
31	Maha Ela at Kaduwela	79.992707	6.933554	L8	Maha Ela after paddy areas & home gardens before Kelani River
32	Kelani River Near Kaduwela Bridge	79.985112	6.936272	M23	After passing several major towns and industrial zones and industrial areas
33	Ratkahawatta Oya at Mabima	79.971984	6.937961	L9	Ratkahawatta Oya after paddy areas & home gardens before joining Kelani River
34	Kolonnawa Ela	79.875021	6.942566	L10	Kollonawa Ela after paddy areas, home gardens and Diyawannawa Oya
35	Kelani River at Peliyagodawatta	79.882271	6.954818	L12	Kelani River before Joining with Kolonnawa Ela
36	Kelani River at Peliyagodawatta	79.878798	6.957791	M24	After highly populated areas & tanneries
37	Hakitta Ela at Hekitta	79.88121	6.9817	M25	After passing populated areas, factories prior to joining the river
38	Hamilton Canal	79.874379	6.986957	L11	Drainage from several major towns and Kerawalapitiya power plant
39	Kelani River Outfall	79.869701	6.979192	M26	Sea outfall

Key points on water quality monitoring:

1. Flow, groundwater depth, or similar water discharge measurements, as well as other hydrologic variable should be measured at the same time with measurements of water quality.
2. Monitoring must continue long enough to detect a response to land treatment with appropriate indicators. Look for creative or alternative indicators of response to treatment
3. Monitoring schedules and locations must be adapted to pollutant behaviour, hydrologic regime, and the watershed land use (industrial, agriculture, urban, waste management etc. etc.).
4. Plot- and field-scale monitoring may provide information on pollutant types that is critical to understanding a water quality response at the river basin, sub-basin or minor watershed levels.
5. Consider carefully designed studies in small watersheds to document the pollution potentials and effects of management and conservation practices as part of an overall watershed project.
6. Evaluate historical water quality data critically before commencing a project as past data may not be usable for present purposes.
7. An understanding of the watershed hydrological system is essential for interpreting monitoring results
8. Water quality monitoring data are essential to the development and application of models to specific watershed
9. Irrespective to how rigorous the water quality monitoring program, it will be impossible to link observed changes in water quality to land uses without rigorous monitoring of management and conservation practices.
10. Integrate water quality monitoring, simulation modelling, and conservation practice implementation into coordinated activities that encourage communication and feedback among participants throughout the project.

Adopted from Meals et. al. (2012)

6.11. Considerations for automation

Real-time automated data gathering is a well-established process in number of countries for measuring water and other environment parameters. One concern in Sri Lanka context is the security of the equipment as some of the potential monitoring sites are located in remote places with limited security. During the KRMP implementation every possibility should be explored to introduce real time monitoring for selected parameters for monitoring and improved preparedness. It is possible to use the stations to be connected via internet as already done by NBRO and ITI for landslide early warnings.

6.12. Use of simulation models

For easy interpretation and visualization, the flow and water quality monitoring along with other soil-water-climate information can be used in computer models. Simulation Models are widely used to predict the water quality in a water body in response to changes in pollutant loading and various management strategies.

The model outputs can be improved much or data visualizations can be better with the use of remotely sensed images. Use of Google based maps and tools plus images captured locally by Unmanned Flights (ex: University of Moratuwa developed system) to strength the information displays, identification of land use issues and support in monitoring the progress.

Content management system (e.g.: USEPA Storage and Retrieval System – STORET) that facilitate the data storage, processing and sharing among agencies, researchers, students and communities is also recommended for KRMP.

6.13. Quality assurance of monitoring data

The quality assurance starts with the sampling design and extend to sampling, analysis, data processing, statistical analysis and Advocacy. Therefore, in KRMP approach a multi-agency quality assurance is proposed as part of the technical committee structure.

Chapter 07: Management arrangements

7.1. Coordination approach

Management arrangements of the implementation of the KRMP approach also need a multi-sector participation, including private sector, civil society etc. A possible management structure was discussed at the stakeholder meeting on November 30, 2015 and it was agreed to study the arrangements adopted for three of the ongoing coordination committees relevant to KRMP coordination:

1. Implementation of the National Policy on the Protection and Conservation of Water Sources, their Catchments and Reservations in Sri Lanka (gazette no.1894/3-Dec.2014) where LUPPD is the Secretariat.
2. Pavithra Ganga Coordination where Sustainable Division of the Ministry of Mahaweli Development and Environment is the Secretariat.
3. National Steering Committee (NSC) of National Action Programme for combating Land Degradation in Sri Lanka (2015-2024) with the leadership of the Secretary in charge of the subject of Environment.

7.2. Steering committees complementary of the KRMP approach

7.2.1. Policy on protection and conservation of water resources, catchments and reservations

The Coordination Committee for National Policy on the Protection and Conservation of Water Sources, their Catchments and Reservations has a number of complementary aspects to the KRMP approach. The committee included institutions related to the subjects such as land, water resources, irrigation, Mahaweli, agriculture, agrarian development, wildlife and forest conservation, Environment and Education are the key institutions.

In terms of the Terms of Reference these agencies shall prepare Corporate Plans, Strategic Plans and Action Plans as to achieve the objectives of the protection and conservation of water sources. The agencies in the committee are:

- Ministry of Land and Land Development
- Ministry of Mahaweli Development and Environment
- Ministry of Plantation Industries
- Ministry of Urban Planning and Water Supply
- Ministry of Irrigation and water Management
- Ministry of Local Government and Provincial Councils
- Ministry of Education
- Land Use Policy Planning Department
- Land Commissioner General's Department
- Survey Department
- Water Resources Board
- National Water Supply and Drainage Board
- Department of Agrarian Development
- Department of Irrigation
- Department of Agriculture
- Central Environment Authority
- Department of Wildlife Conservation
- Department of Forest Conservation
- Mahaweli Authority of Sri Lanka

- Sri Lanka Land Reclamation and Development Corporation
- Urban Department Authority
- Land Reform Commission
- Department of National Physical Planning

7.2.2. National Action Programme for Combatting Land Degradation

The National Steering Committee (NSC) of National Action Programme for combating Land Degradation in Sri Lanka (2015-2024) is chaired by the Secretary, Ministry in charge of the subject of Environment with the Director of the Natural Resource Management (NRM) division of the Ministry of Environment serving as the Secretary to the committee.

The members of the committee are:

- Ministry of Agriculture
- Ministry of Lands and Land Development
- Ministry of Irrigation and Water Resources
- Ministry of Finance and Planning
- Ministry of Plantation Industries
- Biodiversity Secretariat
- Climate Change Secretariat
- Natural Resource Management Centre of Dept. of Agriculture
- Land Use Policy Planning Department
- Forest Department
- Irrigation Department
- Mahaweli Authority of Sri Lanka
- National Building Research Organization
- Central Environment Authority
- Dept. of Wildlife Conservation
- Research Institutes (Tea, Rubber, Coconut…)
- Water Resources Board
- National Physical Planning Department
- Coast Conservation and Coastal Resources Management Department
- Provincial Councils
- Invitees from the Universities, NGO and Corporate Sector

The above committee can decide to invite members for the meetings as and when required in order to ensure successful implementation of the objectives and the Committee is expected to meet quarterly. In terms of the Terms of Reference the Committee will coordinate among national level institutions, take necessary policy decision, support finding financial resources, encourage synergies among the three UN Conventions namely, United Nations Convention on Biological Diversity (CBD), United Nations Framework Convention to Climate Change (UNFCCC), and United Nations Convention to Combat Desertification (UNCCD) and motivate the implementation agencies.

7.2.3. National Steering Committee of Pavithra Ganga Programme

The committee is chaired by the Secretary of the Ministry in charge of the subject of Environment and the Sustainable Development Division of the Ministry of Mahaweli Development and Environment is acting as the Secretariat. Committee is expected to meet every 6 months and the member agencies are:

- Ministry of Mahaweli Development and Environment
- Ministry of Local Government & Provincial Councils
- Central Environment Authority
- National Water Supply and Drainage Board
- Board of Investment Sri Lanka
- Department of Irrigation
- Geological Survey and Mines Bureau
- Land Use Policy Planning Department

- Disaster Management Centre
- 13 Local Authorities in the Kelani River Basin
- Private sector and Civil societies

7.2. Proposed Kelani River Multi-Stakeholder Steering Committee

The Kelani River Basin Multi-Stakeholder Partnership (KRMP) approach has the challenge of managing land resources, employment, ecosystem conservation and service provision at the same time. Being futuristic and respecting the value of catchment protection for water resource management, it is proposed that the Secretary of the Ministry in charge of the subject of Environment takes the lead with the Secretary of the Ministry in Charge of Water Resources as the Co-Chair. The steering committee is proposed to be minimal (maximum of 20) for practical decision making and comprised of senior staff of a few key agencies such as:

- Ministry in Charge of Environment
- Ministry in Charge of Water Resources
- Ministry in Charge of Lands
- Ministry in Charge of Health
- Ministry in Charge of Local Government
- Ministry in Charge of Policy Planning
- Ministry in Charge of Megapolis and Urban Planning
- Ministry of Disaster Management
- Ministry in Charge of Agriculture
- Ministry of Transport
- Ministry of Irrigation
- Private Sector Representative (2)
- Community Representative (2)
- University Representative (2)
- Research Institutes (1)
- Other (2)

7.3. Proposed Terms of Reference for the Steering Committee

The proposed initial Terms of Reference of the National Steering Committee includes:

1. Act as the overall driving force and promote the Kelani River Multi-Stakeholder Partnership (KRMP) approach.
2. Use a technical sub-committees structure to receive inputs to the design elements and implementation of the KRMP approach.
3. Work as the facilitating body for identification and supporting, research, studies, awareness, training and institutional capacity building.
4. Direct the Monitoring and Evaluation of different aspects of the work plan while identifying enhancements to the KRMP approach which is a revolving agenda.
5. Identify policy, institutional and operational gaps and provide/advice to promote corrective measures.
6. Facilitate inter-agency and international collaborations.
7. Provide direction and leadership in resource mobilization efforts.

In addition, this TOR can be amended to better suit the emerging needs during implementation.

7.4. Proposed Sub-Committees for Technical Support

As the number of Steering Committee representation is limited and the subjects involved are complex, in order to provide the adequate technical support, it is proposed to establish a set of technical level committees based on the five Management Objective (MO) Areas. These sub-committees may not only

include the participating agencies but also have technical experts approved by the National Steering committee.

1. Sub-Committee on MO A: Land use management for source water protection and sustainability
2. Sub-Committee on MO B: Industrial and urban management for pollution control and sustainability
3. Sub-Committee on MO C: Research, studies, awareness, training and education for better management and conservation
4. Sub-Committee on MO D: Operationalizing, monitoring and evaluation of the Kelani River Basin Management and Conservation plan
5. Sub-Committee on MO E: Public Private Partnerships contributing towards the sustainability of Kelani River Environment

The KRMP and associated technical sub-committee structure covering Management Objectives will be supported by a well-trained and dedicated staff activing as the "Secretariat" for efficient operation. Secretariat is responsible for coordinating and facilitating the overall integrated planning and implementation approach of the Kelani River Basin management and conservation.

7.5. The Secretariat for the Kelani River Multi-Stakeholder Partnership approach

The KRMP implementation requires the support of a strong, efficient, and client oriented Secretariat. The composition of the Secretariat to be developed once the KRMP approach is approved by the Cabinet of Ministers. The technical positions are aligned with the five Management Objectives and 10 Key Result Areas with a dedicated set of staff ensuring the support services. The location of the secretariat or the Host-Ministry is not decided yet.

There are a number of initiatives planned or under development to support the Secretariat functions

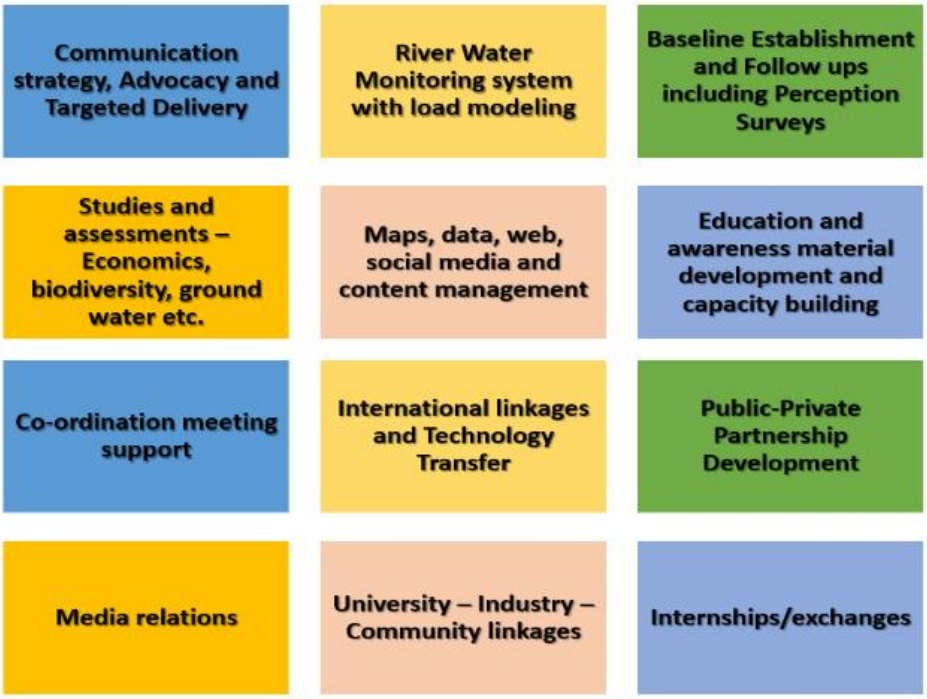

Figure 31: Proposed Support Services and Resources by the Secretariat

including a web page, content management system etc. In addition, the Secretariat will be supporting information exchanges, best practices sharing, baseline establishment and updates, media relations etc., as part of its functions.

7.6. The proposed Terms of Reference for the Secretariat

- Coordination and follow up assistance to the Steering Committee and the Technical sub-committees based on Management Objectives.
- Capacity building of stakeholder agencies and partners at different levels including the support to local level minor-watershed programmes.
- Develop and facilitate Public–Private Partnerships (PPPs) and highlight the successes
- Coordinate with Public Sector large projects and programmes such as Western Region Megapolis.
- Commissioning studies and research as identified by the Steering Committee and Sub-Committees.
- Promote university, community and industry linkages and maintain media relations.
- Develop and maintain the content management system that will be used by multiple parties while promoting the data sharing and use as a guiding principle.
- Develop and maintain international relations, networking and promote best practice sharing.
- Overall in-charge of the monitoring and evaluation framework and its implementation including the updates of baselines and perceptions.
- Develop briefing materials for the Steering Committee and support resource mobilization.
- Promote and give prominence to cross cutting areas such as climate change, gender and due attention to vulnerable groups.
- Facilitate constructive dialogue among stakeholder groups to diffuse conflicts, myths etc.

7.7. Baseline establishment and updating

Baseline assessments using the Management Objective areas and activities outlined at the beginning of the implementation of the KRMP approach are expected to benchmark the current situation and strengthen the information collected at the consultative process. The key baseline data requirements are highlighted in the Activity Plan in Chapter 5 under each Management Objective. In most activities it is proposed to establish the baseline for the given activity at the very outset. Therefore, the overall baseline for the KRMP approach will be greatly informed by the individual work plan activities.

The success of the project monitoring will dependent much on the strength of the initial baseline and periodic updates. Updates would indicate the changes occurred since the beginning of the programme and the extent of the changes attributable to the programme in line with the Monitoring and Evaluation framework provided later in this Chapter. It is recommended that adequate resources are dedicated to maintain the baseline updates not only to record the changes but also highlight the achievements.

In terms of methods to be used in the baseline surveys, there are many qualitative and quantitative methods available for the programme to use. There are also combined qualitative and quantitative methods that may be particularly useful for the KRMP approach and its implementation. The detailed approach for the baseline establishment will be developed at the

"setting-up" phase or in the early part of the implementation.

The changes to the baseline may also reflect in the perceptions of the key stakeholder entities. During the KRMP plan preparation a trial perception survey was carried out, using a limited number of target groups, covering about 200 respondents as summarized in the Chapter 1. It provided a range of qualitative information and justified the need for a multi-stakeholder approach while providing a number of lessons to improve the formal perception surveys planned at the start of the project and during the implementation. Key observations gathered during the trial perception survey in Kelani River Basin included:

1. Survey formats needs to be in local languages
2. Include both Govt. system including GNs, Health staff etc. and citizen groups
3. Instructions to participants to be provided by a trained group or by the same group
4. Participant provided information to be backed by key informant interviews
5. Design of surveys should support continued updates of perceptions in key areas (include a number of questions that are repeated)

7.8. Monitoring and Evaluation

Monitoring and Evaluation (M&E) is important to consolidate information, showcase the progress and take corrective actions to achieve the KRMP Management Objectives.

M&E often generates reports and case studies contributing towards transparency and accountability. It helps in sharing lessons and also forms a basis for questioning and testing assumptions used in the design stage of KRMP highlighting the areas needing further policy, technology and implementation improvements. M&E also helps to identify knowledge management needs, coordination supports needed by multiple agencies/stakeholders and capacity improvements necessary.

With reference to the Kelani River Basin Management and Conservation, monitoring and evaluation can be adopted at the activity level and aggregated upwards to Key Results Areas and then to Management Objective level. Therefore, in the design of KRMP approach potential outputs have been articulated as much as possible in the work plan. In addition to the activity monitoring and evaluation the strong water quality monitoring programme introduced in the KRMP approach covering surface and ground water at basin, sub-basin and minor watershed levels will also inform the M&E at the impact level, as the overall objective of the project is to arrest the pollution of source water in the Kelani River Basin.

At any given time, the level of progress and the contribution by an activity towards the Management Objective can be monitored against a number of parameters as articulated in the M&E Tracking Approach. For example, an activity can be progressing better than the expectations; on target or may not be progressing at all. The Secretariat M&E team can keep track of the status of the activity using the tracking chart for each activity. After sometime certain activities will start contributing towards outputs and some may even contribute towards the overall outcomes or strategic goals. It is expected that all activities may not progress equally well and need additional attention based on the periodic reviews. In addition, the financial progress in percentage and in Rupees should be reported according to the agreed budget items.

	On track to exceed the target	On track to reach the target	Progress noted but not adequate	No significant progress	Things are getting worse
Planning and initiation completed					
Contributions to outputs noticeable					
Demonstrated changes in line with Goals					
Outputs evaluated and ready for replication					
Significant contribution to outcome recorded					

Figure 32: Framework for Monitoring and Evaluation
Adopted by Biodiversity outlook 4

7.9. Capacity Assessment

Implementation of the activities in the KRMP approach requires agencies, stakeholder entities, communities and others to be empowered with adequate capacities relevant to the tasks to be implemented. As per UNDP (2007), capacity is defined as "the ability of individuals, institutions and societies to perform functions, solve problems, and set and achieve objectives in a sustainable manner."

Capacity development (CD) is thereby the process through which the abilities to do so are obtained, strengthened, adapted and maintained over time. A capacity assessment is an analysis of current capacities against desired future capacities, which generates an understanding of capacity assets and needs, which in turn leads to the formulation of capacity development strategies. A capacity assessment determines the capacity needs by comparing desired capacities against existing capacity assets. Capacity enhancements may involve knowledge, skills or resources (equipment, technology, funds etc.). For the KRMP approach it is proposed to carry out a detailed capacity assessment at the early part of the implementation based on Key Result Areas and Management Objectives, preferably in line with the approach of UNDP (2007).

7.10. Proposed setting up phase for KRMP implementation

The KRMP approach finalized at the end of 2015 requires a number of preliminary steps before the initiation of full implementation. Therefore, it may be necessary to adopt a "setting-up" or a "preparatory" phase that would allow the stakeholder agencies and authorities to position in the KRMP approach better.

Technical agencies involved in the preparation of KRMP approach and consultations are well aware of the strategy and its evolution plus the work plan elements. However, there are other entities that needs to be made aware and briefed to get the necessary provisions and legal mandate for the operationalizing of the KRMP approach as a medium to long-term measure.

Setting-up phase may include a number of key areas where the work can be started with limited funding:

1. Briefing of key VIPs on the KRMP approach and design to get the necessary buy-in including the legal approvals. This step may include consultations with key Secretaries on the management modality, proposed steering committee and structures and the establishment of the secretariat. Briefing also need to include the Hon. Ministers and relevant officials who were not part of the process earlier.

2. Development of Public–Private Partnerships that are critical for the success of the basin and minor-watershed level programme support. A team can engage Chambers, Water group of the UN Global Compact in Sri Lanka and also engage individual private sector who are keen in working with the KRMP approach.

3. Development of support materials for the use of the Secretariat and implementation that also include manuals and field guides on different technologies and best practices (e.g.: composting, biogas, constructed wetlands, waste separation and collection and disposal etc.).

4. Start the baseline assessments and setting up of the water quality and flow monitoring stations and protocols proposed in the plan. This step may also include a comprehensive capacity assessment within agencies as well as at the minor-watershed level, based on the activity plan.

5. Increased awareness on the KRMP approach among public and communities in the Kelani River basin, as an orientation. This step may involve social media, news media, TV and other innovative approaches and development of technical brief on key topics (ex: pollution and health linkages; ecosystem services and contributions in the basin).

6. Mapping of stakeholder entities at sub-basin and minor-watershed levels. This will help to develop and strengthen the governance units at the local scale (71 minor-watersheds) and also carry out the first basin wide water quality sampling proposed in the KRMP approach.

Chapter 08: Communication Strategy and School Centred Education

A number of supporting mechanisms are proposed for the successful delivery of the KRMP approach. Three key elements include, the communication strategy, capacity development and the school centred education and awareness.

The capacity development assessment based on the activities will be conducted at the start of the programme or at the setting up phase as indicated in Chapter 07. This Chapter includes the initial details of the communication strategy to be adopted and the illustrative school centred awareness and education programmes proposed. It is also recommended to include both in the annual review during the implementation for the necessary readjustments.

8.1.Communication Strategy

Communication Strategy is based on the context that the "Kelani River Multi-Stakeholder Partnership (KRMP) approach" is focused on protecting catchment ecosystems and minimizing human and natural actions that cause pollution and increase disaster risks. At the same time, it uses a Nature Solutions (Chapter 3.6) that say "Yes" to development while keeping "conservation" at the highest level.

Overarching objective of the ***KRMP communication strategy*** is to support operationalizing the KRMP approach, related strategies and action plans by employing a strong communication thrust.

8.1.1. Preliminary Perception Survey

The preliminary perception survey was carried out to improve the communication approach. Majority of survey respondents (64%) believed that it is not safe to drink water directly from the river (28%), spring (19%) or well (17%) indicating a significant high level of awareness. But the high remainder (36%) highlights the need for detailed information on water safety.

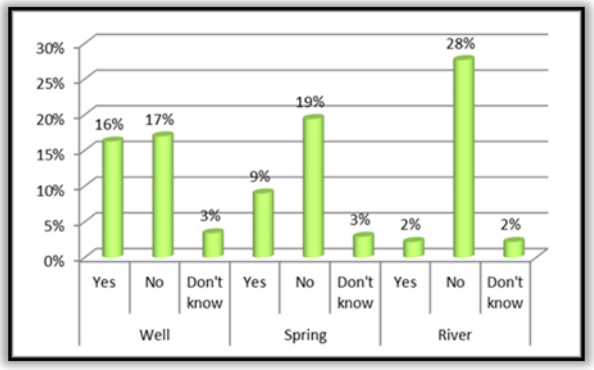

Figure 33: Perception on water safety

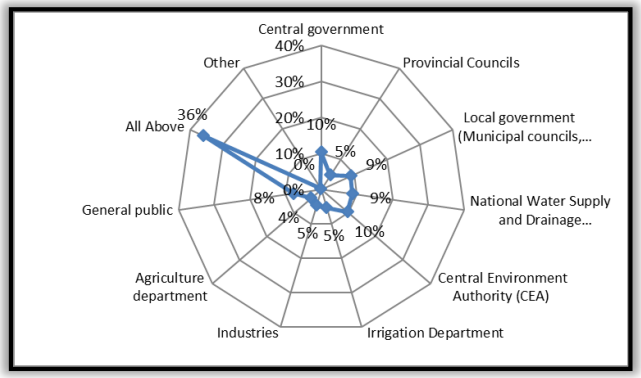

Figure 34: Perception on agency roles

The preliminary perception survey endorsed the need for a multi-agency approach. The participants identified the CEA, NWSDB and Local Government as more responsible for water related actions indicating high expectations on mandated areas such as enforcement by the CEA, water treatment of the NWSDB and service delivery areas such as waste management and industry approvals by the local authorities.

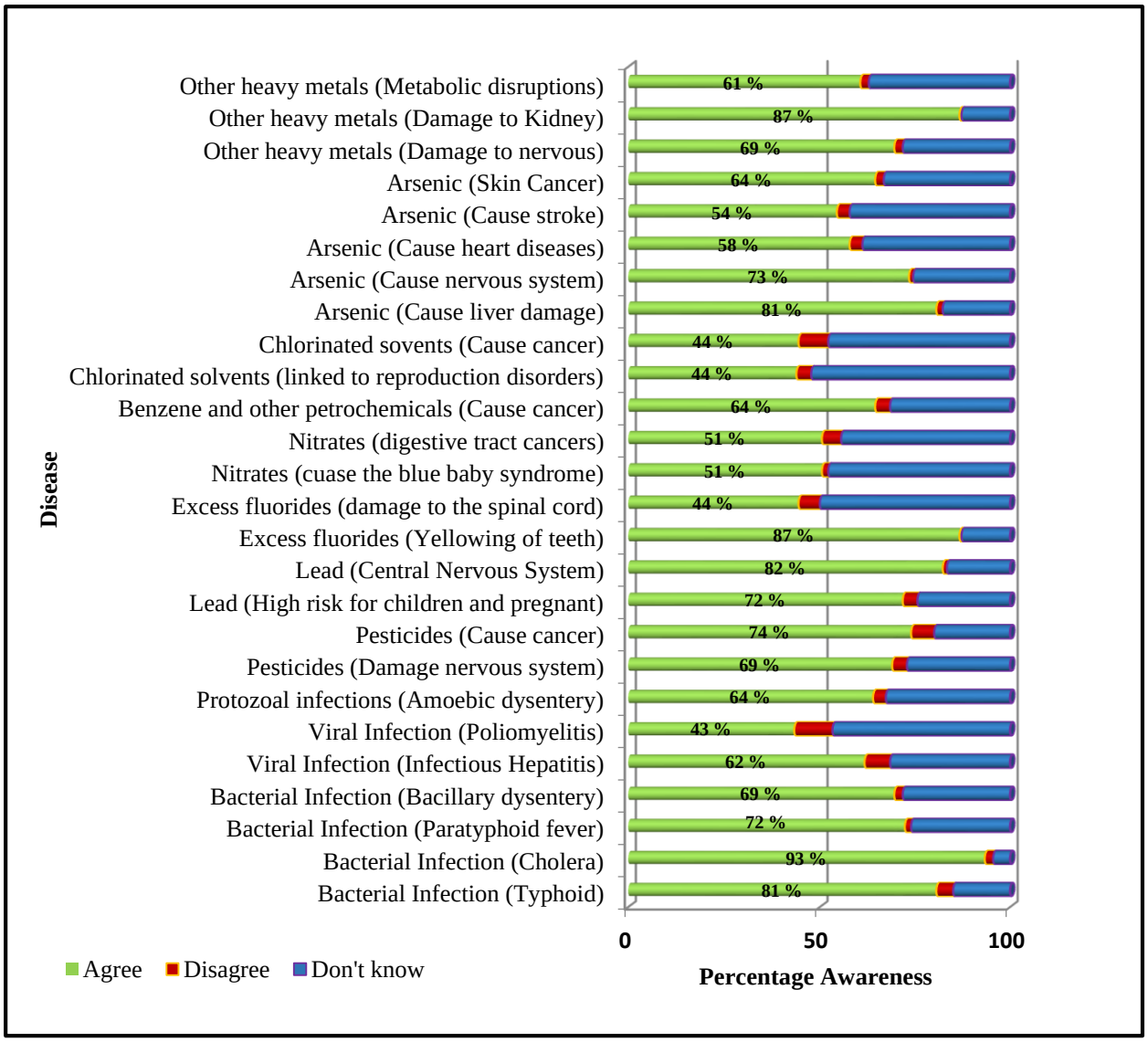

Figure 35: Perception on diseases and water pollution linkages

While identifying the health linkages to water pollution, for the 26 diseases used in the list of potential water related health hazards, over 60% respondents identified 18 diseases as having a connection between the disease and water quality. In the case of 22 diseases more than 20% respondents indicated that they are not sure or do not know whether there is a connection between the water quality and the disease.

In both counts it is evident that more education and awareness intervention in the KRMP approach is justified and communication has a key role to play.

There was a clear indication that where there are propaganda or national debate on diseases or issues the participants were aware of the connection between health problems and diseases. For example, there are a number of TV advertisements on fluoride and yellowing of teeth which was reflected in the survey with over 80%

respondents agreeing that there is a connection of high fluorides in water and yellowing of teeth.

Similarly, the connections between bacteria, typhoid and cholera had been very clear with over or nearly 80% respondents making the connection. Part of the credit of the latter response also should go to Sri Lanka health authorities of their intensive health campaigns especially using village level health professionals.

However, in the cases where the issues are less discussed and known such as excess fluorides damaging spinal code or chlorinated solvents causing cancer and affecting reproductive health, over 40% respondents did not make the health and disease connection.

The above two observations highlighted the possibilities of using an expanded dialogue and use of media to promote knowledge and best practices as part of communications and the potential role for health experts at the basin and minor watershed levels in the KRMP approach.

There was a clear indication during the preliminary survey that much of the treated water supplied by NWSDB is being used for non-drinking purposes, probably due to lack of alternatives.

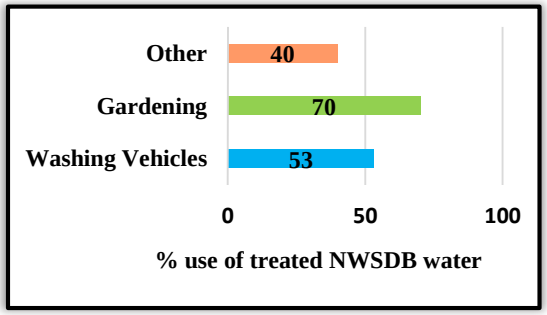

Figure 36: Non portable use of treated water

Majority of survey participants mostly from the Kelani River Basin area used portable water for gardening and vehicle washing etc. This is a large area for improved communication, best practices and technology transfer to minimize treated water for non-portable uses and promote rainwater uses and water efficient technique. At the same time, it may be unrealistic to assume a total prohibition or doing away with NWSDB provided water in non-portable uses. Again economic studies and communication have a major role to play.

The overall understanding of the factors affecting water quality and quantity have been low with 32% of the group responded as “don’t know” which is somewhat challenging as it indicates a significant knowledge gap in terms of understanding the availability and environmental processes behind water.

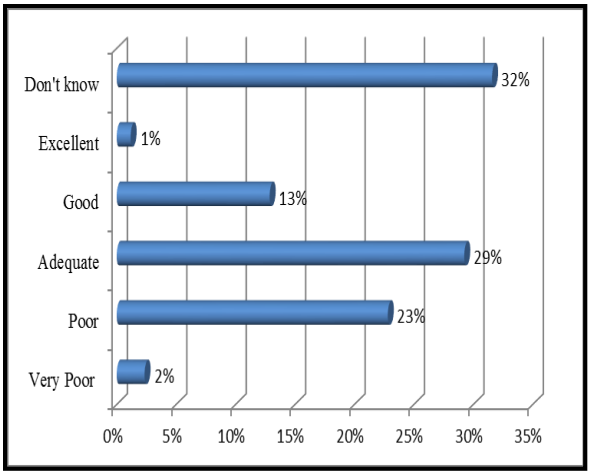

Figure 37: Perception on supply of water and certainty

The awareness, education and communication programmes of the KRMP approach can make use of this observation and develop material on the factors affecting the overall water budget that takes into account the water inputs (rainfall), discharges, ground water recharge, crop uses and other uses. The same will help to promote water use best practices to improve the efficiency of water use as well as capturing water at the surface level (rain water).

Based on the perception survey information and the information collected through the stakeholder consultations it was possible to carry out the following situation analysis to arrive at the communication strategy.

Situation analysis

The communication strategy was developed based on the following SWOT analysis.

Strengths

- KRB is important nationally in many ways (e.g.: 25% population lives; provide drinking water to over 4 million; 10,000 industries providing employment and polluting at the same time)
- Availability of National Policies on Protection of Environment, Conservation of Water Sources; Industrial Waste Management etc. (e.g.: CEA Environment Act, Ministry of Land and Land Development led source water protection, CEA guidelines on establishment of new industrial projects)
- Motivation of key stakeholders (i.e. Policy makers, administrators, media and private sector demonstrated during consultative workshops on KRB planning process during 2014 and 2015) to adopt a strategy to save the Kelani River Basin
- Government priority towards environmental conservation (UDA, 2016 and Sri Lanka NEXT)
- High level of technical skills of the state sector agencies responsible for environment conservation and water supply
- High donor interest on related projects by variety of donors such as UNICEF, World Bank, JICA, WHO etc.

Opportunities

- Findings with alarming information of deteriorating water quality in Kelani River Basin (Chapter 1)
- Proposed KRMP is based on provision of clean drinking water – a subject important in sustainable development and an area of priority
- As the integrated plan for the National Clean River (Pavithra Ganga) programme
- Issues are linked to health and economy, therefore of national importance including Western Region Megapolis
- High prominence given by Govt. for education, health and environment
- Committed, responsible high ranking officials within the implementing partners

Weaknesses

- Weak enforcement capacity in agencies (e.g.: implementation of National Environment Act and Source water protection legislations etc.)
- Inadequacy of trained staff in agencies with local (Sinhala, Tamil) and international language (English) writing skills.
- Poor agency coordination on conservation efforts, research information and sharing of resources
- Lack of a sound water quality and environment monitoring system in the Kelani Basin (CEJ, 2015)

Threats

- Political authorities do not buy-in the KRMP as it involved shifting of employment patterns and high investments on conservation
- Communication and coordination failures between stakeholder agencies

primarily due to leadership and political issues
- Economic priorities winning over environmental conservation priorities
- Continued unplanned development challenging the sustainability of KRMP including industrial and urban expansions

8.1.2. Communication objective and scope

The specific communications objective is to highlight the current status of the river basin and raise the profile of the Kelani River Basin Multi-stakeholder (KRMP) approach to influence and effect the proposed change leading to improved water resources for multiple uses.

Communication strategy is therefore aimed to support the information delivery and capacity building across different scales (national, regional/landscape, community and global levels) thereby creating a quality enabling environment that facilitate the involvement and long-term engagement of internal and external partners to achieve the element of the KRMP approach. It will include internal communications among key agencies involved and external communications to promote the enabling environment.

8.1.3. Key communication issues/challenges

Key communication issues identified for developing this strategy can be listed as follows,

- Lack of comprehensive understanding by key stakeholders of the urgency and relevance of KRB planning
- Lack of awareness and material about the Kelani River Basin management and conservation plan elements
- Lack of mechanisms to reach stakeholder agencies, local government, community leaders, CBOs, school children
- Less than optimal appreciation of the importance and value of improved inter-sectorial coordination among agencies with different mandates
- Lack of entry points for engagement of CBOs
- Lack of systematic analysing, interpretation and sharing of data/information
- Poor and partial law enforcement
- Diverse target audience (high, medium and low intellect public, private sector, school community, etc.)
- Poor communication/liaison skills of officers

Diversity of target audience calls for a set of diverse communication interventions as elaborated below.

8.1.4. Target audiences

Table 24: Target Audiences for Communications

Target audience	Communication intervention
High intellect* general public	Specific awareness and training programmes, subject expert's discussions on TV in local and international languages E.g. "Doramadalawa"
Medium intellect* general public	General awareness and training programmes, Newspaper articles, web posts, social media in local and international languages
Low intellect* general public	General awareness and training programmes, Cartoons, posters on TV, newspapers and social media, dramas in local languages
Private sector water users/ Industrial community/NGOs/CBOs/other targeted communities	Specific awareness and training programmes, general awareness and training programmes, Newspaper articles, web posts, social media in local and international languages and engaging them in water conservation in the industry premises and areas where work force is residing.

	Conducting one-day training programmes on hazard management, solid waste management, natural resource management, causes for pollution, impacts, solutions for water and air pollution and environment law. Conducting an improved version of 10 weeks' extensive certificate course by CEA on environment conservation and pollution control.
School community (teachers and children)	General awareness and training programmes, Newspaper articles, web posts, social media in local and international languages, Specific awareness and training programmes on pilot basis e.g. water quality testing, school competitions
Police community	General awareness and training programmes, Newspaper articles, web posts, social media in local and international languages, Specific awareness and training programmes on pilot basis e.g. Law enforcement for maintaining good water quality
Health community (Medical professionals and field staff)	General awareness and training programmes, Newspaper articles, web posts, social media in local and international languages, Specific awareness and training programmes on pilot basis e.g. Water quality regulations, water quality standards, pollution potentials, water saving and pollution health linkages
Political authority/leadership	Specific engagements (e.g. events/activities for participation and leadership, training and awareness programmes by subject experts on specific issues, messages seeking support to promote KRMP goals and objectives).
Donor community	Dissemination of specific knowledge products such as concept papers, detail proposals and presentations at related forums for active engagement and resource mobilization
People with disabilities	Specific awareness and training programmes by disability communication experts with the support of subject experts

*High, medium, low intellect is a categorization of audience purely on knowledge of KRMP approach leading to management and conservation and the practice of applying such knowledge for decision making.

In the design and implementation of activities the plan has to work with a range of stakeholder groups. Depending on the roles and responsibilities, they can be grouped into:

1. Government agencies in the basin on regulatory, conservation, employment provision, services and specific tasks mandated. National Planning Dept. and National Budget related authorities on finances.

   These groups include, but not limited to, the Central Environment Authority, Land Use Policy Planning Department, Local Authorities (14) in the River Basin, National Water Supply and Drainage Board, Irrigation Department, Geological Survey and Mines Bureau, Gem and Jewellery Authority, Dept. of Agriculture and Dept. of Agrarian Services, Coast Conservation and Coastal Resources Management Department.

2. Non-Govt. stakeholder groups working with the Govt. agencies and independently with communities important in facilitating KRMP approach at basin and minor watershed levels.

3. Mass media has a special responsibility in the KRMP implementation. On one hand it has a key role to simplify technical material and inform different audiences. On the other hand the mass media reports needs to be science based to the maximum extent and free of speculations, especially on reporting sensitive incidents on water pollution.

4. Private sector playing an extremely important role with about 10,000 industries located within the KRB. These companies employ a large number of people and keen in helping the conserving and management in the areas where their employees get first-hand benefits

and also to contribute to the larger programme, in general.

5. Schools are a special category very important in the conservation and management work. School children are helpful in awareness and education and also to take key messages to the family and communities.
6. Universities (local and abroad) with the capacity of adding knowledge and using the KRMP approach as a training, education and capacity building platform.
7. International agencies interested in conservation as well as helpful in transferring knowledge on river basin management that can extend to best practices, technologies and expertize. In addition, some of the agencies can be donors for various components.

Based on the literature and stakeholder consultative sessions key stakeholder entities a number of illustrative communication needs by a number of agencies are presented in the table below under key water related areas/issues.

Table 25: Key issues, ongoing activities, responsible agency and required communication materials

Key area/issue	Ongoing activities	Responsible agency	Communication materials required
Raw water quality deterioration (Point and NPS)	Conservation and management of catchment areas; planning tools; modelling	FD, LUPPD, SLLRDC	Introductory leaflets/brochures, booklets, posters
Raw water quality deterioration	Protection of river banks; stream flow monitoring	ID, CC & CRM (within 2 Km from river mouth)	Audio-visual documentary
Sewage discharge; Industrial discharge; NPS pollution; Storm Water; Ground Water	Water quality monitoring; Industrial permits; ground water studies	CEA, NWSDB, WRB	Introductory leaflets/brochures, booklets, posters Presentations
Raw water quality deterioration (Point and NPS)	Developing and Institutionalizing Water Safety Planning (WSP)	NWSDB	Presentations, reports
Mining related river an bank deteriorations	Regulating sand mining by issuing license	Geological Survey and Mines Bureau(GSMB)	Audio-visual documentary
Erosion; Agricultural pollution; Aquaculture residues	Soil conservation; raising awareness; mapping; demonstrations; climate change forecasts	Natural Resources Management Centre of Department of Agriculture	Bill boards, Introductory leaflets/brochures, booklets, posters
Sewage discharge; Solid waste; storm water	Management of solid waste	Solid waste management Authority, Local Authorities(LAs)/ CEA	Audio-visual documentary
Pollution; environment management; ecosystems; soil,	Education and Awareness	CEA, NWSDB, Education Department, Relevant Agencies	Bill boards, Introductory Leaflets/brochures, booklets, posters

water and climate processes			Presentations, Audio-visual documentary
Pesticide and fertilizer policies	Sustainable use of Agricultural lands	Department of Agriculture (DoA)	Audio-visual documentary
Regulatory compliance; strategic planning;	Coordination and monitoring of the project activities.	CEA and Ministry of Mahaweli Development &Environment, Ministry of Urban Development & Water Supply	Reports
Water quality/quantity, protected areas and ecosystem services	Protection of Peak Wilderness Sanctuary; compliance	Department of Wildlife Conservation(DWC)	Audio-visual documentary
Forest Degradation and ecosystem services	Protection Forest Reserves (e.g.: Kelani valley; Uda Malimbada; Labugama-Kalatuwawa; Idikada Makulana)	Forest Department	Audio-visual documentary
National policy on clean rivers and pilot testing of approaches	Implementing Pavithra Ganga Programme	Ministry of Environment	Presentations, Audio-visual documentary
International standards and best practices on Water safety	Introducing guidelines for drinking water quality and support WSP	World Health Organization(WHO)	Presentations, leaflets/brochures, booklets, posters
Promotion of catchment protection	Establishing a multi stakeholder approach, piloting WSPs for CBO Managed Water, incorporation Water Safety in Education Curriculum	United Nations Children's Fund(UNICEF)	Presentations, leaflets/brochures, booklets, posters, reports
Dam safety; Community water supply; climate change; investments on infrastructure	Pipe borne water; Sewerage treatment; plants; planning for risk reduction by diseases and climate change	The World Bank (Approved and will be commencing September 2015)	Presentations, leaflets/brochures, booklets, posters, reports
Wastewater reuse; solid waste management; composting; information on water management	Conducting related research	International Water Management Institute(IWMI)	Presentations, leaflets/brochures, booklets, posters, reports
Watershed planning; water quality monitoring	Support to CEA, NWSDB on watershed plans; information dissemination on water conservation and regulation and river bank classification for Kelani River Basin	Japan International Cooperation Agency (JICA)	Audio-visual documentary

8.1.5. Communication result areas

KRMP approach understood and endorsed

The Kelani River Basin Multi-Stakeholder Management and Conservation Plan involves engagement of diverse group of stakeholders such as administrators, regulators, authorities, private sector, donors, non-government agencies. Effective delivery of technical information on health-pollution linkages, water pollution impacts on the ecosystem sustainability, socio-economic implications of degradation of the catchment and river basin plays an important role on the success of KRMP implementation. Therefore, from the inception a strong communication effort is required to support a) identify, understand and engage on key issues; b) develop partnerships, agency synergy and entry points; c) buy-in of implementing agencies to the common approach; and d) acceptance by the National Planners to be included in budget process that allows local and external assistance.

KRB plan elements, mechanisms and roles clearly understood

KRB plan elements including the Management Objectives, Key Results Areas, Actions and agency roles plus implementation mechanisms needs to be understood clearly by the stakeholder groups. The communications will have to continue to focus on and provide scientific data and information on Kelani River issues and potential technological, management and conservation interventions/solutions. The communications contributions also required to strengthen internal communication among agencies on their roles and contributions within the overall plan, individually or collectively, towards achieving the objectives of the plan. This will include descriptions of roles of agencies, monitoring/progress information, recognition of contributions plus the information on value added efforts by scientific community, general public, private sector, schools and donors.

Resource mobilization and sustainability supported

Approved KRMP approach including the activities will enable the project to access Govt. of Sri Lanka annual budget and gain the interest of donors and private sector to collaborate. A significant amount of planned effort on information and communications are needed to the project to understand the donor and private sector interests and out of the project to market the KRMP among donors and private sector.

Illustrative Communication Activities

In order to achieve the desired results and to target specific groups at different stages of the project plus to ensure the continued interest of all stakeholder entities including private sector groups and civil society the communication activities will be designed covering following key aspects.

- Project inception related communications: introductory phase to improve the understanding
- Pilot site communications: awareness of activities and improve the involvement
- Lessons learnt communications: convening results and communicating to key policy makers. This is an education phase where results from economic, legal and technology plus best practices implementation among internal audiences
- External communications with reports, multi-media and others to share the lessons learnt and best practices

8.1.6. Selected communicators for awareness raising and trainings

Communications work best if target group's focus is steadily on the present and on a subjects of common interest. Therefore, communication planning needs to define clearly the communication focus in relation to respective situations such as target audience, time, and topic and the message. Lack of communicator or communication focus may fail to achieve the expected positive changes of target audience. Selection of communicators and instruments is important to achieve the communication objectives of KRMP approach.

8.1.7. Key communication messages

- Water resources as a key component in development
- The institutional framework for water resources management and conservation in Sri Lanka
- The bigger picture on the status of water resource in Kelani River Basin in terms of quantity and quality
- Implications of fragmented planning without adequate consideration of multi-sector approach for managing and conserving Kelani River Basin (KRB)
- Human induced environmental degradation and pollution of water resource
- The rationale/importance of community participation in planning, implementation, monitoring of the management and conservation of KRB
- Provision of water supply and sanitation services at minimal subsided cost
- Role of people living in the river boundary
- High priority for proper management of municipal and industrial waste
- Preventing agricultural pollution with adopting environmental friendly practices
- Selecting the most appropriate and affordable technology for ensuring safe water supply, sewerage and sanitation services
- The mechanism for effective consultation and consensus building and participation of stakeholders in the decision making process
- Familiar with water related policies and regulations
- Private sector as a water user with a cooperate social responsibility of conserving Kelani River Basin
- Engaging school children in managing and conserving Kelani River Basin

8.2. School centred awareness and education

The school cantered approach will initially be based on the well-developed "Environment Pioneer Programme (EPP)" programme of the Central Environment Authority (CEA) while adding focus towards the KRBP requirements with the support from National Water Supply and Drainage Board (NWSDB) education efforts. As the efforts through EPP gaining momentum the activities will be expanded to include communities, private sector and other stakeholder groups. Promoting dialogue among schools and encouraging students to get recognized by participating in competitions, debates, field tours and other events is a strategy that can be supported.

The objectives of enhancing the knowledge and engaging school children are to ***increase the knowledge level on human health, ecosystems and potential damage to health and environment as a result of not paying adequate attention on pollution pathways including Kelani River degradation.***

By doing so the programme will engage communities through school children towards direct or support roles for implementing KRMP prescribed activities. This approach will allow private sector and other entities to enter into the programme by way of providing resources, resource people and student recognition programmes.

Table 26: Schools under CEA Environment Pioneer Programme in KRB districts

1	Kegalle	244
2	Rathnapura	56
3	Kandy	399
4	Nuwara Eliya	19
5	Gampaha	55
6	Colombo	75
7	Kalutara	262
	Total	1,110

Source: CEA (2015)

The legal provisions for school centred education on environment is provided by the circular no. 2003/37 and circular no.2008/11 on conducting Environment Pioneer Programme. Accordingly, principals, teachers and school children were systematically empowered towards an environmental conservation accountability framework.

Over 1,100 schools in the districts related to the Kelani River Basin may participate in KRB activities under the EPP with each school at a minimum of 25 EPP members including the Principal, Teacher in Charge of EPP and students enrolled in EPP. Each school can have up to five EPP teams according to CEA.

It is proposed to expand the EPP activities in the Kelani River Basin schools. The EPP is already geared towards addressing water related issues. In addition to the support to regular programme KRMP may add value by including a one-day camp to provide an opportunity to engage students in management and conservation activities. As such each district may have a camp as a main activity along with a number of other activities promoting eco-friendly practices. Typical school environment extension programme targeting communities could take about 5 hours. For example, the monthly school awareness programme for 3-4 hours conducted at CEA with a field visit to “Thalangama wewa” (nearby water body) for environment observation covering selected topics can be highlighted.

The National Water Supply and Drainage Board (NWDSB) conducts two-hour school programmes using material and information on water safety, watershed conservation (both ground and surface) and pollution control. EPP programme of CEA and NWSDB may enhance the technical inputs enriched with more educational material and also provide engagement opportunities to students and communities.

Further, the school led awareness and education can be integrated with the minor-watershed level programmes to provide students opportunities to collect information for class projects and participate in competitions.

8.2.1. Proposed 3-hour school programme

Capitalizing on the features of EPP programme with the NWSDB school programme for schools in the Kelani River Basin.

Table 27: Proposed three hour programme

SN	Theme of the presentation/video	Duration	Responsible Agency
	Refreshments		
1	Address by the School Principal/ Teacher in Charge	10 minutes	School principal/ Teacher in Charge
2	Importance of water and conservation of river basin with a special emphasis on Kelani River	15 minutes	NWSDB/CEA
3	Danger of water unavailability	15 minutes	NWSDB
4	Purifying river water for drinking	15 minutes	NWSDB
5	Pipe born drinking water with a subside price	15 minutes	NWSDB
6	Conserving water unseen; ground Water conservation	15 minutes	WRB
7	Eco friendly school; A video documentary	15 minutes	CEA
8	Our role in environment and river basin conservation; Environment Pioneer Brigades	15 minutes	CEA
9	Q & A	30 minutes	NWSDB
10	Engage in river basin conservation; competitions, recognition of the champions and way forward	10 minutes	NWSDB and CEA
11	Feedback by participants	15 minutes	NWSDB and CEA

8.2.2. Proposed 5-hour programme for EPP one-day camp

Table 28: Proposed five hour programme

SN	Theme of the presentation/video	Duration	Responsible Agency
	Providing refreshments		
1	Address by the host	10 minutes	School principal/ Teacher in Charge
2	Importance of water and conservation of river basin with a special emphasis on Kelani River	15 minutes	NWSDB/CEA
3	Danger of water unavailability	15 minutes	NWSDB
4	Purifying river water for drinking	15 minutes	NWSDB
5	Pipe born drinking water with a subside price	15 minutes	NWSDB
6	Conserving water unseen; ground Water conservation	15 minutes	WRB
7	Eco friendly school; A video documentary	15 minutes	CEA
8	My role in environment and river basin conservation; Environment Pioneer Programme	15 minutes	CEA
9	Discussion by the participants of potentials of engaging in river basin conservation; competitions,	30 minutes	NWSDB, CEA, Environment Pioneer Brigades

SN	Theme of the presentation/video	Duration	Responsible Agency
	recognition of the champions and way forward		
10	Importance of hydrology and water quality testing in collaboration with the Globe Programme and CEA	1 hour	Ministry of Education, CEA
11	First Aid Training	1.30 hours	Sri Lanka Red Cross
12	Feedback by participants	10 minutes	NWSDB and CEA, Environment Pioneer Brigades

8.2.3. Media outreach

The KRMP approach will include a range of TV, print media and radio programmes with multiple media partners. Details designs of the programmes will be worked out at the early stages of implementation and in the setting up phase proposed.

These media work may also include discussions forums, debates among schools on selected topics and has room for much innovation. Some of the media campaigns in school communities could be focused around celebrating nationally and internationally important environment related days.

Table 29: Nationally and Internationally Celebrated Days

Date	Declared day
02 February	World Wetlands Day
08 March	International Women's Day
10 March	National Transport Day
22 March	World Water Day
23 March	World Climate Day
07 April	World Health Day
22 April	International Earth Day
21 May	World Cultural Day
22 May	International Day Biological Diversity
05 June	World Environment Day
08 June	World Oceans Day
17 June	World Desert Prevention Day
11 July	World Population Day
16 September	International Day for the Prevention of the Ozone Layer
27 September	World Tourist's Day
01 October	World Children's and Elders Day
03 October	World's Habitats Day
04 October	World Animal Day
14 October	World Standards Day
15 October	National Tree Planting Day
16 October	World Food Day
16 October	National Farmers day
24 October	United Nations Day
11 December	International Mountains Day

8.2.4. Potential partnerships

In order to disseminate knowledge linking up with the educational programmes such as the UNICEF funded school programmes and GLOBE programme by The Ministry of Educational can be highlighted. In addition, the private sector partnerships are recommended for sponsoring media programmes celebrating environment related days and champion recognitions.

8.2.5. Private sector engagement

Private sector may enter into the school programme by participating at different levels.

1. Basin level programmes
2. Sub basin level programmes
3. Minor watershed or site specific programmes

These basin and sub-basin level programmes are linked very much to the signature programmes in the KRMP by private sector. For example, students can be encouraged in waste collection, recycling and water conservation.

Site specific programmes could be the projects the private sector is leading as CSR or other that can be used by students to study and share knowledge. In this case field tours sponsored by private sector and students using the knowledge in class assignments and providing feedback to private sector projects are anticipated.

8.2.6. Community participation

Communities are encouraged to participate on awareness education activities at the sub-basin or minor-watershed programmes where involvement of students may be higher. These include student participation in small environment projects under the KRMP and working with student's side by side on water quality monitoring and understanding of health and pollution linkages.

In addition, the communities can develop environmentally friendly projects (along with private sector too) and provide opportunities for students to observe and learn through the projects. For example, community led composting, biogas, rainwater harvesting, organic farming, waste recycling etc. would provide good background for student learning and some of these projects can be used by students for their class room projects and assignments.

8.2.7. Combining health and conservation in communities

Around the world there are emerging efforts to use nature as a healing place. For example, the "Healthy Parks Healthy People" is an effort that was started by Victoria Parks in Australia (http://parkweb.vic.gov.au/) presently spreading around the world. Healthy Parks Healthy People seeks to reinforce and encourage the connections between a healthy environment and a healthy society. The concept is behind the fact that the new generations are "Nature Deprived" and focus more on electronics and widgets (phones, Pads and computer games etc.) thereby losing the touch with nature on one hand and getting sick physically and mentally in the process.

In this context the KRMP approach and its Public-Private Partnership related Management Objective can create an enabling environment to involve communities to create urban gardens, trails and use them in health and education efforts.

Chapter 9: In Conclusion

9.1. Urgency and commitment

The timing of the **"Medium to Long-Term Strategy and Action Plan for Management and Conservation of the Kelani River Basin"** is in line with the Buddhist concept of "Health is Wealth."

One of the most valuable water resource of the country is being threatened with pollution. At the same time the management process selected needs to balance the socio-economic benefits and conservation benefits. The strategy and action plan outlined herein uses a sustainable approach to be implemented with a sense of urgency.

The multi-stakeholder and multi-sector nature of the programme design based on Nature Based Solutions is expected to create ownership by the stakeholder entities to the KRMP approach and improve coordination among interventions.

However, the effectiveness and the speed of reaching the outcomes leading to safe drinking water depends on the commitment and motivation of stakeholder entities including the senior government and resources available.

9.2. Costs vs benefits

River basin restoration involves low cost best practices as well as high cost infrastructure and technologies. However, considering the human health and ecosystem damages, the pollution can cause in the long-term, it will be extremely difficult to evaluate the benefits of this intervention.

At a time, the country is facing a Chronic Kidney Disease of an uncertain origin (CKDu) in intermediate and dry zones, in which case the cost to the nation is yet to be known, it may be worthwhile to invest on the KRMP approach on the management and conservation of the Kelani River Basin to minimize potential health issues in the wet-zone. The classical cost benefit analysis used in project evaluation or infrastructure investment may not apply in this context.

9.3. Win-win Scenario

Once this Action Plan is implemented with a detailed understanding by the stakeholder groups including the school children (next generation) it may have a profound impact on the perceptions, attitudes and approaches towards the sustainable use of natural resources in the country.

Active participation at all levels is expected to improve our appreciation of the ecosystem services.

Therefore, the KRMP approach has the potential to be a local and a global model of balancing socio-economics and source water protection with science, training, capacity building, awareness and enforcement that can be replicated. The capacities build through the project has the ability to last long and applicable to many river basins.

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Annexures

Annexure 1: Proposed water quality standards

Source: Draft Group 1 (Environment) Report, Western Region Megapolis Planning (unpublished, 2015)

Inland Water Quality Standards **Parameter**	**Unit type of limit**	**Class I waters**		**Class II waters**			**Irrigation and agriculture Category 6**	**Class III waters**
		Nature Conservation Category 1	**Drinking water with simple treatment Category 2**	**Bathing Category 3**	**Fish and Aquatic life Category 4**	**Drinking water with conventional treatment Category 5**		**Minimum quality (other uses) Category 7**
General								
1.Colour (after simple filtration)	Pt mg/L, max	n	20	-	-	100	-	-
2.Total dissolved solids(TDS)	mg/L, max	n	-	-	-	-	500	-
3. Conductivity	dS/m, max	n	-	-	-	-	0.7	-
4.Odor		n			-		-	-
5. Taste		n		-	-		-	-
6.Turbidity	NTU, max	n	5	-	-	-	-	-
7.Sodium absorption ratio (SAR)		n	-	-	-	-	6-15	-
8.Residual sodium carbonate (RSC)	mq./L, max	n	-	-	-	-	1.25	-
9.Total hardness	as $CaCO_3$ mg/L,max	n	250 des. 600 max.	-	-	-	-	-
10.pH	-	n	6.0-8.5	6.0 - 9.0	6.0 - 8.5	6.0 - 9.0	6.0-8.5	5.5 - 9.0
11.Dissolved Oxygen at 25^oC	mg/L, min	n	6	5	3	4	3	3
12.BOD (5days at 20^oC or 3 days at30^oC)	mg/L, max	n	3	4	4	5	5	5
13. COD	mg/L, max.	n	15	20	15	30	-	40

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Parameter	Unit type of limit	Class I waters		Class II waters			Irrigation and agriculture Category 6	Class III waters
		Nature Conservation Category 1	Drinking water with simple treatment Category 2	Bathing Category 3	Fish and Aquatic life Category 4	Drinking water with conventional treatment Category 5		Minimum quality (other uses) Category 7
Nutrients								
14.Nitrates (NO_3 - N)	mg/L, max	n	5	5	5	5	5	5
15. Total ammonia (NH3- N) -pH < 7.5 -pH = 8.0 -pH = 8.5	mg/L, max	 - - -	 0.94 0.59 0.22	 - - -	 - - -	 - - -	 - - -	 9.1 4.9 1.6
16.Total phosphate (PO4 - P)	mg/L, max	n	0.7	0.7	0.4	0.7	0.7	0.7
Other Substances								
17. Chlorides (Cl)	mg/L, max	n	200	-	-	200	100	-
18. Cyanides (CN)	mg/L, max	n	0.005	0.005	0.005	0.005	0.005	0.005
19. Fluorides (F)	mg/L, max	n	1.5	-	-	1.5	-	-
20. Sulphates (SO_4)	mg/L, max	n	250	-	-	250	1000	-
Metals								
21.Total cadmium (Cd)	µg/L, max	n	5	-	H Cd <60 0.2 60-120 0.8 120-180 1.3 >180 1.8	5	-	5
22. Total chromium (Cr)	µg/L, max	n	50	-	2	50	-	50
23. Total copper (Cu)	µg/L, max	n	-	-	H Cu <60 2 60-120 2 120-180 3 >180 4	-	-	100
Parameter	**Unit type of limit**	**Class I waters**		**Class II waters**			**Irrigation and agriculture Category 6**	**Class III waters**
		Nature Conservation Category 1	**Drinking water with simple treatment Category 2**	**Bathing Category 3**	**Fish and Aquatic life Category 4**	**Drinking water with conventional treatment Category 5**		**Minimum quality (other uses) Category 7**
24. Iron (Fe)	µg/L, max	n	300 des 1000 max	-	300	200	-	-

25. Lead (Pb)	µg/L, max	n	50	-	H Pb <60 1 60-120 2 120-180 4 >180 7	50	-	50
26. Manganese (Mn)	µg/L, max	1000	1000	1000	1000	1000	1000	1000
27. Mercury (Hg)	µg/L, max	n	1	1	0.1	1	1	2
28. Nickel (Ni)	µg/L, max	n	100	100	H Ni <60 25 60-120 65 120-180 110 >180 150	100	100	100
29. Selenium (Se)	µg/L, max	n	10	10	1	10	-	-
30. Zinc (Zn)	µg/L, max	n	1000	1000	30	1000	1000	1000
31.Boron (B)	µg/L, max	n	-	-	-	-	500	-
32. Total arsenic (As)	µg/L, max	n	10	50	50	10	50	50
33. Aluminium (Al)	µg/L, max	n	200	-	-	200	5.0	-
Organic Micro Pollutants								
34. Phenol index	µg/L, max	n	2	5	1	5	5	5
35. Oil and grease	µg/L, max	n	100	200	10	100	-	300
36. Anionic surfactants(detergent) as MBAS	µg/L, max	n	200	300	1000	200	1000	1000
37. Total pesticides	µg/L, max	n	10	30	30	30	50	50
Micro Organisms								
38. Total coliform	MPN/100 ml, (*P=9%)	n	5000	1000	20,000	5000	1000	-
39. Fecal coliform	MPN/100 ml, (*P=95%)	n	250 des 600 max	50	-	-	-	-

[1] It is not required to name any inland waters for this purposes because water for this purposes can be taken from any other uses category subject to very specific parameter values

Abbreviations:

n - Nature or baseline values
H - Hardness in terms of CaCO3 in mg/l
des. - Desirable highest level
max. - Maximum permissible level
MBAS - Methylene blue active substances
*P=95% - 95% of the samples give a value that is equal to or less than the indicated limit

Annexure 2: Declared inland water, industrial discharge and water quality limits

The Central Environment Authority has prescribed the following limits for water quality for different purposes under the gazette extraordinary of the Democratic Socialist Republic of Sri Lanka on February 01, 2008. These standards will form the basis and guidance for Water Safety Planning (WSP) and implementation at the sub-basin and minor-watershed levels.

Annexure 2 - Table 1: Tolerance limits for discharge of industrial waste water into inland surface waters

No.	Parameter	Unit type of limit	Tolerance limit values
1	Total suspended solids	mg/L, max.	50
2	Particle size of the total suspended solids	µm, less than	850
3	pH at ambient temperature	-	6.0 - 8.5
4	Biochemical oxygen demand (BOD_5 in five days at 200c or BOD3 in three days at 270c)	mg/L, max.	30
5	Temperature of discharge	^{0}C, max.	Shall no exceed 400 C in any section of the stream within 15 m downstream from the effluent outlet
6	Oils and greases	mg/L, max.	10
7	Phenolic compounds (as C_6H_5OH)	mg/L, max.	1
8	Chemical oxygen demand (COD)	mg/L, max.	250
9	Colour	Wavelength Range	Maximum spectral absorption coefficient
		436 nm (Yellow range)	$7m^{-1}$
		525 nm (Red range)	$5m^{-1}$
		620 nm (Blue range)	$3m^{-1}$
10	Dissolved phosphates (as P)	mg/L, max.	5
11	Total Kjeldahl nitrogen (as N)	mg/L, max.	150
12	Ammonical nitrogen (as N)	mg/L, max.	50
13	Cyanide (as CN)	mg/L, max.	0.2
14	Total residual chlorine	mg/L, max.	1
15	Fluorides (as F)	mg/L, max.	2
16	Sulphide (as S)	mg/L, max.	2
17	Arsenic (as As)	mg/L, max.	0.2
18	Cadmium (as Cd)	mg/L, max.	0.1
19	Chromium, total (as Cr)	mg/L, max.	0.5
20	Chromium, Hexavalent (as Cr^{6+})	mg/L, max.	0.1
21	Copper (as Cu)	mg/L, max.	3
22	Iron (as Fe)	mg/L, max.	3
23	Lead (as Pb)	mg/L, max.	0.1
24	Mercury (as Hg)	mg/L, max.	0.0005
25	Nickel (as Ni)	mg/L, max.	3
26	Selenium (as Se)	mg/L, max.	0.05
27	Zinc (as Zn)	mg/L, max.	2
28	Pesticides	mg/L, max.	0.005
29	Detergents/surfactants	mg/L, max.	5
30	Fecal Coliform	MPN/100 ml, max	40
31	Radio Active Material:		
	(a) Alpha emitters	micro curie/ml, max	10^{-8}
	(b) Beta emitters	micro curie/ml, max	10^{-7}

Note 1: All efforts should be made to remove unpleasant odour as far as possible.
Note 2: These values are based on dilution of effluents by at least 8 volumes of clean receiving water. If the dilution is below 8 times, the permissible limits are multiplied by the 1/8 of the actual dilution.
Note 3: The above mentioned general standards shall cease to apply with regard to a particular industry when industry specific standards are notified for that industry.
Note 4: Pesticides as per World Health Organization (WHO) and Food and Agriculture Organization (FAO) requirements.

Annexure 3: Tolerance limits - industrial waste discharged on land for irrigation

Annexure 3 - Table 1: Limits for industrial waste discharges to land for irrigation

No	Parameter	Unit type of limit	Tolerance limit value
1	Total dissolved solids	mg/L, max.	2100
2	pH at ambient temperature		5.5 - 9.0
3	Biochemical oxygen demand (BOD 5 in five days at 200 C or BOD 3 in three days at 27^0c)	mg/L, max.	250
4	Oils and greases	mg/L, max.	10
5	Chemical Oxygen Demand (COD)	mg/L, max.	400
6	Chlorides (as C1)	mg/L, max.	600
7	Sulphates (as SO_4)	mg/L, max.	1000
8	Boron (as B)	mg/L, max.	2.0
9	Arsenic (as As)	mg/L, max.	0.2
10	Cadmium (as Cd)	mg/L, max.	2.0
11	Chromium, total (as Cr)	mg/L, max.	1.0
12	Lead (as Pb)	mg/L, max.	1.0
13	Mercury (as Hg)	mg/L, max.	0.0
14	Sodium adsorption ratio (SAR)		10 15
15	Residual sodium carbonate (RSC)	mo1/L, max.	2.5
16	Electrical conductivity	µS/cm. max.	2250
17	Fecal coliform	MPN/100m1, max.	40
18	Copper (as Cu)	mg/L, max.	1
19	Cyanide (as CN)	mg/L, max.	0.2
20	Radio Active Material:		
	(a) Alpha emitters	Micro curie. /m1, max.	10^{-9}
	(b) Beta emitters	Micro curie/m1, max.	10^{-8}

Annexure 4: Dosage of settled industrial effluents on soils

Annexure 4 - Table 1: Effluent dosage based on soil texture

No	Soil Texture Class	Recommended dosage of settled Industrial Effluents (m3 /ha/day)
1	Sandy	225 - 280
2	Sandy loam	170 - 225
3	Loam	110 - 170
4	Clay loam	55 - 110
5	Clay	35 - 55

Annexure 5: Limits for waste from rubber factories into inland surface waters

Annexure 5 - Table 1: Rubber waste limits to inland surface water

No	Parameters	Unit type of limits	Tolerance limit value	
			Type I* Factories	Type II** Factories
1	pH value at ambient temperature		6.5 to 8.5	6.5 to 8.5
2	Total suspended solids	mg/L, max.	100	100
3	Total Solids	mg/L, max.	1500	1000
4	Biochemical Oxygen Demand, BOD_5 in five days at 20^0C or BOD_3 in three days at 27^0C	mg/L, max.	60	50
5	Chemical Oxygen Demand (COD)	mg/L, max.	400	400
6	Total Nitrogen (as N)	mg/L, max.	300	60
7	Ammonical Nitrogen (as N)	mg/L, max.	300	40
8	Sulphides (as S)	mg/L, max.	2.0	2.0

Crepe Rubber and Ribbed Smoked Sheets

Note I: All efforts should be made to remove unpleasant odour and colour as far as practicable.

Note 2: These values are based on dilution of effluents by at least 8 volumes of clean receiving water. If the dilution is below 8 times, the permissible limits are multiplied by the 1/8 of the actual dilution.

Annexure 6: Limits for waste from textile industry into inland surface waters

Annexure 6 - Table 1: Limits of textile waste to inland surface waters

No	Parameter	Unit type of limit	Tolerance limit value
1	pH at ambient temperature		6.5 to 8.5
2	Temperature	^{0}C, max.	40 measured at site of sampling
3	Total suspended solids	mg/L, max.	50
4	Biochemical oxygen demand (BOD 5 in five days at 200 C or BOD 3 in three days at 27^{0}c)		60
5	Colour	Wavelength Range	Maximum spectral absorption coefficient
		436 nm (Yellow range)	7m^{-1}
		525 nm (Red range)	5m^{-1}
		620 nm (Blue range)	3m^{-1}
6	Oils and grease	mg/L, max.	10
7	Phenolic compounds (as Phenolic OH)	mg/L, max.	1.0
8	Chemical Oxygen Demand (COD)	mg/L, max.	250
9	Sulphides (as S)	mg/L, max.	2.0
10	Chromium total (as Cr)	mg/L, max.	2.0
11	Hexavalent Chromium (as Cr^{+6})	mg/L, max.	0.5
12	Copper, total (as Cu)	mg/L, max.	3.0
13	Zinc, total (as Zn)	mg/L, max.	5.0
14	Ammonical nitrogen (as N)	mg/L, max.	60
15	Chloride (as Cl)	mg/L, max.	70

Note I : All efforts should be made to remove unpleasant odour and colour as far as practicable.

Note 2 : These values are based on dilution of effluents by at least 8 volumes of clean receiving water. If the dilution is below 8 times; the permissible limits are multiplied by the 1/8 of the actual dilution.

Annexure 7: Limits for waste from tanning industry into inland surface waters

Annexure 7 - Table 1: Limits for tanning waste to inland surface water

No	Parameter	Unit type of limit	Tolerance Limit values for Effluents Discharged into Inland Surface Water	Tolerance Limit values for Effluents Discharged into Marine Coastal Areas
1	pH value at ambient temperature	0_C	5.5 - 9.0	5.5 - 9.0
2	Total suspended solids	mg/L, max.	100	150
3	Biochemical oxygen demand (BOD 5 in five days at 200 C or BOD 3 in three days at 27^0c)	mg/L, max.	60	100
4	Chemical Oxygen Demand (COD)	mg/L, max.	250	300
5	Colour	**Wavelength Range**	**Maximum spectral absorption coefficient**	
		436 nm (Yellow range)	$7m^{-1}$	
		525 nm (Red range)	$5m^{-1}$	
		620 nm (Blue range)	$3m^{-1}$	
6	Alkalinity (as Ca CO_3)	mg/L, max.	750	
7	Chloride (as C1)	mg/L, max.	1000	
8	Hexavalent Chromium (as Cr^{+6})	mg/L, max.	0.5	0.5
9	Chromium total (as Cr)	mg/L, max.	2.0	2.0
10	Oils and Grease	mg/L, max.	10	20
11	Phenolic Compounds (as phenolic OH)	mg/L, max.	1.0	5.0
12	Sulphides (as S)	mg/L, max.	2.0	5.0

Note: These values are based on dilution of effluents by at least 8 volumes of clean receiving water. If the dilution is below 8 times, the permissible limits are multiplied by the 1/8 of the actual dilution.

Annexure 8: Effluent discharges limits to public sewers with central treatment

Annexure 8 - Table 1: Limits for effluent discharges to public sewers with treatment

No.	Parameter	Unit type of limit	Tolerance Limit values
1	Total suspended solids	mg/L, max.	500
2	pH at ambient temperature	-	5.5 - 10.0
3	Temperature	^{0}C, max.	45
4	Biochemical oxygen demand (BOD5 in five days at 200 C or BOD3 in three days at 270C)	mg/L, max.	350
5	Chemical Oxygen Demand (COD)	mg/L, max.	850
6	Total Kjeldahl nitrogen (as N)	mg/L, max.	500
7	Free ammonia (as N)	mg/L, max.	50
8	Ammonical nitrogen (as N)	mg/L, max.	50
9	Cyanide (as CN)	mg/L, max.	2
10	Total residual chlorine	mg/L, max.	3
11	Chlorides (as Cl)	mg/L, max.	900
12	Fluorides (as F)	mg/L, max.	20
13	Sulphide (as S)	mg/L, max.	5
14	Sulphates (as SO_4)	mg/L, max.	1000
15	Arsenic (as As)	mg/L, max.	0.2
16	Cadmium (as Cd)	mg/L, max.	1
17	Chromium total (as Cr)	mg/L, max.	2
18	Copper (as Cu)	mg/L, max.	3
19	Lead (as Pb)	mg/L, max.	1
20	Mercury (as Hg)	mg/L, max.	0.005
21	Nickel (as Ni)	mg/L, max.	3
22	Selenium (as Se)	mg/L, max.	0.05
23	Zinc (as Zn)	mg/L, max.	5
24	Pesticides	mg/L, max.	0.2
25	Detergents/surfactants	mg/L, max.	50
26	Phenolic compounds (as phenolic OH)	mg/L, max.	5
27	Oil and Grease	mg/L, max.	30
28	Radio Active Material:		
	(a) Alpha emitters	Micro curie. /m1, max.	10^{-9}
	(b) Beta emitters	Micro curie/m1, max.	10^{-8}

The following conditions should be met:

* discharge of high viscous material should be prohibited.
* Calcium Carbide sludge should not be discharged.
* substances producing inflammable vapours should be absent.

Annexure 9. Wastewater discharge standards for discharging into water bodies & coastal waters

Annexure 9 - Table 1: Tolerance Limits for Discharge into Inland and Coastal Waters

No	Parameter	Unit	Tolerance limit values		
			Discharged into Inland Waters		
			Sensitive Waters (CLASS II Waters)	General water (CLASS III Waters)	Discharged into coastal waters
1	pH at ambient temperature		6.0 - 8.5	6.0 - 9.0	5.5 - 9.0
2	Temperature	^{o}C, max	N +4	N +7	N +8
3	Total suspended solids	mg/L, max.	20	50	150
4	Biochemical oxygen demand (BOD_5 at 20^{o}C or BOD_3 at 30^{o} C)	mg/L, max.	30	50	100
5	Chemical oxygen demand (COD)	mg/L, max.	150	250	250
6	. Colour	Wavelength Range 400-499nm (Yellow range) 500-599 nm (Red range) 600-750nm (Blue range)	Maximum spectral absorption coefficient 7 m^{-1} 5 m^{-1} 3 m^{-1} (to be rounded up to the nearest 0.1 m^{-1})	Maximum spectral absorption coefficient 7 m^{-1} 5 m^{-1} 3 m^{-1} (to be rounded up to the nearest 0.1 m^{-1})	
7	Odour	-			
8	Dissolved phosphates (as P)	mg/L, max.	5.0	5	-
9	Total Kjeldah1 nitrogen	mg/L, max.	100	150	-
10	Free ammonia (as N)	mg/L, max.	10	-	-
11	Ammonical nitrogen (as N)	mg/L, max.	50	50	50
12	Cyanide (as CN)	mg/L, max.	0.1	0.2	0.2
13	Total residual chlorine	mg/L, max.	0.2	1.0	1.0
14	Chlorides (as Cl)	mg/L, max.	1000	-	-
15	Fluorides (as F)	mg/L, max.	2.0	10	15
16	Sulfide (as H_2S)	mg/L, max.	1.0	2.0	5.0
17	Arsenic (as As)	mg/L, max.	0.1	0.2	0.2
18	Cadmium (as Cd)	mg/L, max.	0.1	0.2	2.0
19	Chromium, total (as Cr)	mg/L, max.	0.5	2.0	2.0
20	Chromium, Hexavalent (as Cr^{6+})	mg/L, max.	0.1	0.1	1.0
21	Copper (as Cu)	mg/L, max.	0.5	2.0	3.0
22	Iron (as Fe)	mg/L, max.	3.0	3.5	-
23	Lead (as Pb)	mg/L, max.	0.1	0.5	1.0
24	Mercury (as Hg)	mg/L, max.	0.0005	0.005	0.01

25	Nickel (as Ni)	mg/L, max.	0.5	2.0	5.0
26	Selenium (as Se)	mg/L, max.	0.05	0.1	0.1
27	Zinc (as Zn)	mg/L, max.	2.0	3.0	5.0
28	Pesticides	mg/L, max.	0.005	0.05	50
29	Detergents/ surfactants	mg/L, max.	5	15	-
30	Phenolic compounds (as C_6H_5OH)	mg/L, max.	0.5	1.0	5.0
31	Oil and grease	mg/L, max.	10	10	20
32	Fecal coliforms	MPN/100 ml, max	40	40	60

Annexure 10: Industry types in CEA A, B, and C industry categories

A Type:

Chemicals manufacturing or formulating or repacking industries; Soaps, detergents, softener or any other cleansing preparations manufacturing industries having a production capacity of 1,000 kilograms per day or more; Bulk petroleum liquid or liquefied petroleum gas storage or filling facilities having a total capacity of 150 or more metric tons excluding vehicle fuel filling stations; Industries involved in the use of fiberglass as a raw material where 10 or more workers are employed; Synthetic rubber, natural rubber manufacturing or processing or rubber based industries excluding industries which manufacture less than 100 kilograms of ribbed smoke rubber sheets per day; Activated carbon or carbon black manufacturing industries or charcoal manufacturing industries having a production capacity one or more metric ton per batch; Industries involved in manufacturing extracting or formulating Ayurvedic, Indigenous medicinal products where 25 or more workers are employed; Chemical fertilizer manufacturing, formulating, processing or repacking Industries; Pesticides, insecticides, fungicides and herbicides manufacturing, formulating or repacking industries; Oil (mineral oil or petroleum) refineries; Dye and dye intermediate manufacturing or formulating industries; Paints (emulsion or enamel), inks, pigments, varnish, polish manufacturing or formulating industries; Petrochemical (basic or intermediates) manufacturing or formulating industries; Industrial gas manufacturing, processing or refilling industries; Asphalt processing plants; Industries involved in the manufacture of polymers or polymer based products (i.e. polyethylene, polyvinyl chloride (PVC), polyurethane, polypropylene, polyester, nylon, polystyrene, resins, fibreglass or other manmade fibres etc.) or polymer or polymer based products, recycling industries.; All types of tyres, tubes manufacturing or tyre re-treading industries; Industries involved in manufacturing or reconditioning of batteries; Any industry involved in the use of asbestos fibres as a raw material; Industries involved in manufacturing, extracting or formulating pharmaceuticals or cosmetic products including intermediates; Adhesives manufacturing industries excluding natural gums; Match sticks manufacturing industries and explosives manufacturing or formulating industries; Batik industries where 10 or more workers are employed; Textile processing (i.e. bleaching, dyeing, printing) industries or garment washing industries or textile sand blasting industries or commercial laundries where 10 or more workers are employed; Tanneries; Lather finishing industries having effluent generating operations; Jute processing industries; Industries involved in bleaching or dyeing of natural fibre or natural fibre based industries where 25 or more workers are employed; Power looms having 25 or more machines or power looms with sizing activities; Sugar manufacturing industries or sugar refineries; Fermentation industries (Distilleries, Breweries) or alcoholic beverages bottling plants or bottling plants having bottle washing operations; Food manufacturing and processing industries including bakery products and confectioneries where 25 or more workers are employed; Abattoirs; Coconut oil or cinnamon oil extraction industries where 25 or more workers are employed, Plants or animal oil/fats extraction industries having production capacity of 10 litres or more per day excluding coconut oil and cinnamon oil extraction industries, Instant tea or coffee processing industries, Non-alcoholic beverages manufacturing industries where 25 or more workers are employed, Desiccated coconut mills or coconut processing industries where 10 or more workers are employed; Rice mills having wet process and having a production capacity of 5,000 kilograms or more per day; All hatcheries or poultry farms having 2,500 or more birds or piggery, cattle, goats farms having animals 50 or more or having rating* for mixed farming 2,500 or more.[*Rating for Mixed Farming = No. of Birds + 50 x (No. of Pigs + No. of Cattle + No. of Goats)]; Animal feed manufacturing industries having a capacity of 25 or more metric tons per day; Cigarettes or other tobacco products manufacturing industries where 50 or more workers are employed; Industries involved in surface treatment of metal or plastic including electroplating, galvanizing and powder coating industries; Iron and steel mills; Foundries with any type of furnaces; Non-ferrous metal processing industries including secondary process, smelting and recovery of metals; Metal fabricating industries or machinery, machinery parts or hardware items or electrical and electronic goods and equipment manufacturing or assembling industries where 24 or more workers are employed. (Including lathe workshops, welding shops, spray painting industries); Cement industries (clinker grinding, manufacturing or repacking); Concrete batching plants having a production capacity of 50 or more cubic meters per day; Glass or glass based product manufacturing industries; Lime kilns having a production capacity of 20 or more metric tons per day; Ceramic industries where more than 25 or more workers are employed; Mechanized mining activities with multi bore hole blasting or single bore hole blasting activities with production

capacity having 600 or more cubic meters per month; Crushing or processing of non-metallic minerals (i.e. limestone, dolomite, apatite. Rock phosphate, sand stone, feldspar, quartz, ilmenite, rutile, zircon, mica, graphite, kaolin, etc.) excluding lime shell and granite crushing activities; Granite boulders making or processing industries (extracting, blasting, slicing, polishing); Granite crushing (Metal crushing) industries having a total production capacity of 25 or more cubic meters per day; Common wastewater (industrial or sewage) treatment plants; Incinerators having a feeding capacity of 5 or more metric tons per day; Water treatment plants having a treatment capacity of 10,000 or more cubic meters per day; Municipal solid waste and other solid waste composting plants having a capacity or 10 or more metric tons per day; Solid waste recovery/recycling or processing plants having a capacity of 10 or more metric tons per day; Solid waste disposal facility having a disposal capacity of 10 or more metric tons per day; All toxic and hazardous waste treatment facility or disposal facilities or recycling/recovering or storage facilities; Industries involved in chemical treatment and preservation of wood excluding Boron treatment; Saw mills having a milling capacity of 50 or more cubic meters per day or wood based industries where 25 or more workers are employed; Hotels, guest houses, rest houses having 20 or more rooms; Hostels and similar dwelling places where occupancy level is exceeding 200 or more; Health care service centres generating infectious wastes, including medical laboratories and research centres; Automobile or bicycle manufacturing or assembling industries; Vehicles service stations or container yards having vehicle service activities excluding three wheeler and motor cycles services and interior cleaning; Railway workshops or all bus depots having vehicle servicing activities; All vehicle emission testing centres; Electrical power generating utilities excluding standby generators and hydro or solar or wind power generation; Printing presses with lead smelting o newspaper printing or printing process which generates wastewater or colour photographs processing centres; Paper and Pulp Industries or corrugated cartons manufacturing industries; Any industry where 200 or more workers per shift are employed; Industrial Estates approved under the part IVC of the National environmental Act including Katunayake and Biyagama Export processing Zones; Zoological gardens; Transmission towers providing facilities for telecommunication and broadcasting; Any industry not included above which discharges 10 or more cubic meters of wastewater per day or using toxic chemicals in its process.

B type:

Soaps, detergents, softener or any other cleansing preparations manufacturing industries having a production capacity less than 1,000 kilograms per day; Bulk petroleum liquid storage facilities excluding filling stations or liquefied petroleum gas (LP Gas) storage or filling facilities having a total capacity less than 150 metric tons; industries involved in the use of fibre glass as a raw material where less than 10 workers are employed; Ribbed smoke rubber sheet manufacturing industries having a production capacity of more than 50 kilograms and less than 100 kilograms per day; Activated carbon or carbon black manufacturing industries or charcoal manufacturing industries having a production capacity less than one metric ton per batch; Industries involved in manufacturing, extracting or formulating Ayurveda, indigenous medicinal products where more than 10 workers and less than 25 workers are employed; Batik industries where less than 10 workers are employed; Commercial laundries where less than 10 workers are employed; Leather finishing industries having dry process operations; Natural fibre based industries where less than 25 workers are employed excluding industries involved in bleaching or dyeing of natural fibre; Power looms having less than 25 machines; Hand Looms or knitting or embroidery industry having more than 10 looms; Garment industries where 25 or more workers and less than 200 workers per shift are employed; Sugar cane based industries excluding sugar factories of sugar refineries; Food manufacturing and processing industries including bakery products and confectioneries where 5 or more workers and less than 25 workers are employed; Cinnamon oil extracting industry where less than 25 workers are employed; Rice mills having wet process with a production capacity of less than 5,000 kilograms per day; Grinding mills having production capacity of more than 1,000 kilograms per month; Poultry farms have 250 or more and less than 2,500 birds or piggery, cattle, goats farms having animals 5 or more and less than 50 or having rating * for mixed farming 250 and less than 2,500 [* Rating for Mixed Farming = No. of Birds + 50 x (No. of Pigs + No. of Cattle + No. Goats)]; Animals feed manufacturing industries, having a capacity of less than 25 metric tons per day; All ice manufacturing industries; Metal fabricating industries or machinery, machinery parts or hardware items or electrical and electronic goods and equipment manufacturing or assembling industries where less than 25 workers are employed. (including lathe workshop, welding shops, spray painting industries); Concrete batching plants having a capacity less than 50 cubic meters per day; Single borehole blasting with industrial mining activities

using explosives, having a production capacity of less than 600 cubic meters per month; Granite crushing (Metal crushing) industries having a total production capacity of less than 25 cubic meters per day excluding manual crushing operations using hand tools; Municipal solid waste and other solid waste composting plants (excluding household composting) having a capacity of less than 10 metric tons per day; Solid waste recovery/recycling or processing plants having a capacity of less than 10 metric tons per day; Solid waste disposal facilities a disposal capacity of less than 10 metric tons per day; Hostels and similar dwelling places where occupancy level or 25 or more boarders and less than 200 borders; Vehicle repairing and maintaining garages including spray painting or mobile air-conditioning activities; Recycling or recovering centres of refrigerants form air-conditioners or refrigerators; Three wheeler or motor cycle servicing activities or vehicle interior cleaning activities; Any industry not included above which discharges 3 or more and less than 10 cubic meters of industrial processing wastewater per day.

C Type:

All vehicle filling stations (liquid petroleum and liquefied petroleum gas); Manufacturing of candles where 10 or more workers are employed; Coconut oil extraction industries where 10 or more workers and less than 25 workers are employed; Non-alcoholic beverages manufacturing industries where 10 or more workers and less than 25 workers are employed; Rice mills having dry process operations; Grinding mills having production capacity of less than 1,000 kilograms per month; Tobacco barns; Cinnamon fumigating industries with sulphur fumigation having capacity of 500 or more kilograms per batch; Edible salt packing and processing industries; Tea factories excluding instant tea processing; Concrete pre-cast industries; Mechanized cement blocks manufacturing industries; Lime kilns having a production capacity of less than 20 metric tons per day; Plaster of Paris industries where less than 25 workers are employed; Lime shell crushing industries; Tile and brick kilns; Single borehole blasting with artisanary mining activities using explosives, having capacity of less than 600 cubic meters per month; Saw mills having a milling capacity of less than 50 cubic meters per day or industries involved in Boron treatment of wood or timber seasoning; Carpentry workshops which use multipurpose carpentry machine or wood based industries where more than 5 workers and less than 25 workers are employed; Residential hotels, guest houses, rest houses with 05 or more and less than 20 rooms; Vehicle repairing or maintaining garages excluding spray-painting or mobile air-conditioning activities; Repairing, maintaining or installation centres of refrigerators and air-conditioners; Container yards excluding where vehicle servicing activities are carried out; All electrical and electronic goods repairing centre where more than 10 workers are employed; Printing presses and later press machines excluding lead smelting.

Source: *Gazette Extraordinary* No. 1159/22 dated 22.11.2000

Annexure 11: Selected Global Experiences on River Basin Management

Ganga Action Plan(GAP) for Ganga River Basin, India

https://wateractionhub.org/projects/view/99/

Watershed characteristics: The largest river basin in India (length=45,000 km, 46 medium river basins, states of Uttarakhand, Uttar Pradesh, Haryana, Himachal Pradesh, Delhi, Bihar, Jharkhand, Rajasthan, Madhya Pradesh, Chhattisgarh and West Bengal)

Pollution issues - During lean flows turbidity level unfit for bathing, reduced Dissolved Oxygen (DO) below 5.0 mg/l but with fluctuations. Coliform exceeds permissible level 2500MPN/100 ml

Approach/Solutions - Central government declaring Ganga river as the national river and set up National Ganga River Basin Authority (NGRBA) in 2009, empowered as planning, financing, monitoring and coordinating authority for effective abatement of pollution and conservation of the river.

Tamar catchment conservation programme, England

http://www.catchmentbasedapproach.org/south-west/tamar

Watershed characteristics - The catchment of the River Tamar and its tributaries (total land area of around 1,800 sq. km in the South West of England). In addition to the River Tamar, the wider catchment includes the Rivers Tavy, Plym and Yealmn (drain areas of 200 sq. km, 170 sq. km and 125 sq. km respectively in the south east of the catchment), and the Rivers Lynher and Tiddy (drain a combined area of ~220 sq. km into the south western side of the Tamar estuary). The urban area of Plymouth, in the south of the Tamar Catchment, occupies around 8,000 ha (4% of the catchment area) while the three other main towns; Holsworthy, Launceston and Tavistock, occupy areas of 130, 450 and 500 ha, respectively. Four significant lakes in the catchment; Upper Tamar Lake (38 ha), Lower Tamar Lake (15 ha), Burrator Reservoir (52 ha) and Roadford Lake (266 ha), and, at the southern end of the catchment, the landscape is dominated by the Tamar (3,000 ha) and Yealm (200 ha) estuaries.

Pollution issues - Deterioration of water-bodies/ecosystems resulting disappearing of a near-natural and healthy condition challenging the delivery of ecosystem services.

Approach/Solutions –

Phase 1: Promoting shared understanding of the issues in the catchment, developing a toolbox of interventions, identify multifunctional land

Phase 2: Action planning for catchment change (who is going to do deliver the interventions and how the funding streams will be integrated to ensure cost- effective realization of benefits).

a) Identify the infrastructural components or characteristics in the landscape of the catchment that play a role in the delivery of the ecosystem service;
b) Characterize the current distribution of features in the catchment and discuss the current status of ecosystem service delivery and factors inhibiting the delivery;
c) Define a series of interventions that could be delivered into the landscape to enhance the delivery of the ecosystem service and to characterize areas where this delivery might be targeted to achieve the greatest enhancement in the service for the least investment of resources. This targeting of measures include consideration of factors affecting the suitability and/or feasibility

of delivery in a particular location based on cost-benefit, appropriateness of delivery, the likelihood of successful outcomes being achieved and the maintenance of balanced ecosystem service delivery.

d) Identify the current sources of funding that are available for the enhancement of the ecosystem service and discuss the potential for these resources to be re-targeted to achieve greater environmental benefits. Also, to identify where current funding could be augmented through the development of new funding mechanisms in the catchment. This element very much encompasses the consideration of who the beneficiaries of the ecosystem service are, where and how they experience the benefits, whether they already pay for the service in some way and who could/should pay for it in the future.

Tamar Estuary & North Esk Catchment, Tasmania, Australia

http://epa.tas.gov.au

Watershed characteristics - The Tamar and its tributaries (drain a catchment area of approximately 10,000 km2, comprising over one fifth of Tasmania's land mass in north east and central Tasmania). Topography in the catchment varies from the low hills and rolling plains characteristics of the agricultural regions in the Northern Midlands, to the high peaks and plateaus of the Western Tiers, Ben Lomond Range and Eastern Highlands. The Tamar Estuary extends along a south east to north west axis for approximately 70 km, following a meandering path.

Pollution issues - water pollution, land degradation, sound pollution, ecosystem degradation, improper handling of waste without classification, poor facility regulation and less than optimal policy development and implementation.

Approach/Solutions - A good supply of fresh, clean water is an essential requirement for human life, a healthy environment and a productive economy. Water is needed for drinking, recreational activities like fishing, swimming and boating, food production, generate clean electricity and support mining and other industries. Rivers and lakes are to look healthy, and provide a healthy environment for a wide range of aquatic plants and animals.

After public consultation and with approval of the planning authorities, Protected Environmental Values were then finalized and a final paper prepared. The Protected Environmental Values are elaborated in the park management plans, used for Natural Resource Management and considered in water management planning. Facilitating online reporting or calling on litter and pollution activities, introducing estuary programmes and river rehabilitation programmes.

Chesapeake Bay Programme, United States of America

http://www.chesapeakebay.net/

Watershed characteristics - 165,760 km2 (64,000 sq. miles), 30,262 km (11, 684 miles) of shoreline, 150 rivers and streams, home to over 17 million people.

Pollution issues - Poor water quality, harvest pressure that challenge the health of species across the region, land and resources fragmentation and degradation of the habitats.

Approach/Solutions –

Since the Chesapeake Bay Program's foundation in 1983, its partners have used written agreements to guide the restoration of the nation's largest estuary and its watershed. Setting goals and tracking progress holds partners accountable for their work, while developing new agreements over time ensures our goals are aligned with the best available science to attain restoration success. This Programme is led by goals related to water quality, toxic contaminants, climate resilience, land conservation, stewardship, public access, and environmental literacy. *Bay TMDL -A Commitment to Clean Water;* Actions are being taken across six states and the District of Columbia to reduce water pollution in local streams and rivers in connection with EPA's Total Maximum Daily Load to restore the Chesapeake Bay.

The Bay TMDL, a historic and comprehensive "pollution diet," was established in December 2010 based largely on implementation plans prepared by Delaware, District of Columbia, Maryland, New York, Pennsylvania, Virginia, West Virginia. In 2012, the jurisdictions submitted Phase II implementation plans designed to strengthen the initial cleanup strategies and reflect the involvement of local partners. They also submitted a first set of two-year milestones outlining near-term restoration commitments.

Thames - Sydenham Water Source Protection Programme, Ontario, Canada

http://www.sourcewaterprotection.on.ca/

Watershed characteristics - Source Protection Areas based on the watershed boundaries of Ontario's 36 Conservation Authorities. The Thames-Sydenham and Region is made up of the watersheds of Upper Thames River, Lower Thames Valley and St. Clair Region.

Pollution issues - Drinking water source is contaminated with a specific strain of Escherichia coli (E. coli) and Campylobacter bacteria.

Approach/Solutions –

Phase 1; A total of $21 million was made available over the first three years from spring 2007 to spring 2010 for stewardship projects such as well decommissioning and upgrading, septic system inspections and upgrades, runoff and erosion control, pollution prevention reviews for businesses and other best management practices and public education. Many have been completed, but some are still underway across Ontario.

Phase 2; An additional $7 million has been allocated for a voluntary program, similar to the earlier phase, but addresses specific local drinking water threats identified by Source Protection Committees through the Source Protection Assessment Reports. The program is being delivered by Conservation Authorities to landowners and businesses through an application process. development of Threat Policy Discussion Papers, development of draft policies, policy pre-consultation, development of the draft proposed Source Protection Plan and development of proposed Source Protection Plan. Conservation products such as Cardstock Folder 2009 Early Actions Program Brochure, Contact your local

Conservation Authority for available funding and eligibility. Clean Water Act Timelines 2009 Fact Sheets on wellhead Protection Areas 2009, intake protection zones, highly vulnerable areas, water quality and water quantity issues, what landowners can do to protect water, septic systems, runoff, erosion protection and additional best management practices, business reviews Interactive CD ROM Watershed Connections; Website: http://www.ene.gov.on.ca/en/water/cleanwater/cwa-factsheets.php include fact sheets on preparing and implementing Source Protection Plans, Roles and Responsibilities .

The Bay TMDL is a key part of an accountability framework to ensure that all pollution control measures needed to fully restore the Bay and its tidal rivers are in place by 2025, with practices in place by 2017 to meet 60 percent of the necessary pollution reductions.

Upper Mississippi River Conservation Programme, USA

http://www.umrcc.org/River%20Issues.html

Watershed characteristics - Mississippi River basin as, "the body of the Nation." The "upper body," upstream of the confluence with the Ohio River, includes commercially navigable reaches and branching tributaries that are recreationally and environmentally important. Together they feed and shelter an array of fish and wildlife in their flowing channels, floodplain lakes, backwaters, wetlands, and floodplain forests. Approximately 12 million user days (one user day equals one person visiting the river for one day) occurred in 76 counties along the Upper Mississippi River (UMR). Recreationists spend about $ 400 million annually and support 7,000 jobs regionally. Excluding the Missouri River, the UMR drains approximately 189,000 square miles with a main-stem floodplain area of approximately 1.3 million acres. It is a riverine system of national and international significance and supports one of the most diverse and productive large river fisheries in the world. The UMR is home to approximately 164 species of fish and supports both a recreational and commercial fishery. Most fish species inhabiting the UMR are not considered to be either recreational or commercial, but all are equally as important for the continued health and maintenance of this truly magnificent aquatic resource. Five states belong to UMR are Minnesota, Wisconsin, Iowa, Illinois and Missouri.

Pollution issues - Non-point pollution such as agricultural runoff, toxins from municipal, agricultural and industrial sources, and contaminated sediments continue to threaten UMR aquatic resources. Ammonia from municipal and industrial sources is of particular concern because it is very toxic to aquatic life and is suspected of contributing to declines in fingernail clams and aquatic vegetation such as wild celery. High sedimentation rates in UMR backwaters threatening many wetland and aquatic habitats converting to less-desirable upland habitat types in the next few decades. In addition, barge fleeting and barge spills have all degraded fish and wildlife resources to some degree threatening the survival.

Approach/Solutions - Effective river management requires knowledge about factors controlling the dynamics and interactions of important ecosystem components. The Long Term Resource Monitoring Program is the prized diagnostic tool in the Environmental Management Program for the Upper

Mississippi River System that provides critical information about the status and trends of key environmental resources.

Current UMR activities are governed by an Executive Board which consists of one voting representative from each of the five UMR states: Wisconsin, Minnesota, Illinois, Iowa, and Missouri. Chairmanship of the Executive Board rotates from year to year. Also on the Board are nonvoting members consisting of five Technical Committee Chairmen (Fisheries, Wildlife, OREIT, Water Quality, and Law Enforcement) two Committees (Mussel and Vegetation), an observer from the Upper Mississippi River National Wildlife and Fish Refuge, and the UMRCC Coordinator. The Executive Board meets twice yearly to prioritize UMRCC conservation-oriented activities and issues which are carried out by the Coordinator and the Technical Sections.

In addition to the state conservation agencies and the Fish and Wildlife Service, several other organizations participate as cooperators. Professionals from the three US Army Corps of Engineers Districts (St. Paul, Minnesota, Rock Island, Illinois, and St. Louis, Missouri) are represented on the Technical Sections and provide support to many UMRCC activities. Government agencies such as the Environmental Protection Agency, U.S. Geological Survey, U.S. Coast Guard, U.S. Department of Agriculture, and state natural resource departments are key contributors to the UMRCC. Other organizations such as the Upper Mississippi River Basin Association, The Izaac Walton League of America, and the Environmental Protection Agency also participate in UMRCC functions.

Annexure 12: Terms of References (TORs) for selected future studies

1. Groundwater assessment procedure – Water Resources Board

2. Terms of reference (TOR) for pesticide and hazardous waste management in Kelani River basin - National Aquatic Resource Research and Development Agency (NARA)

3. Preliminary Ideas for Application of Economics Tools in Kelani River Basin Management and Conservation – IUCN

4. Detail Biodiversity Assessment for Kelani River Basin – IUCN

5. Land use planning in the Kelani River Basin – LUPPD

Terms of Reference (TOR) for Groundwater Assessment Procedure by Water Resources Board

Introduction:

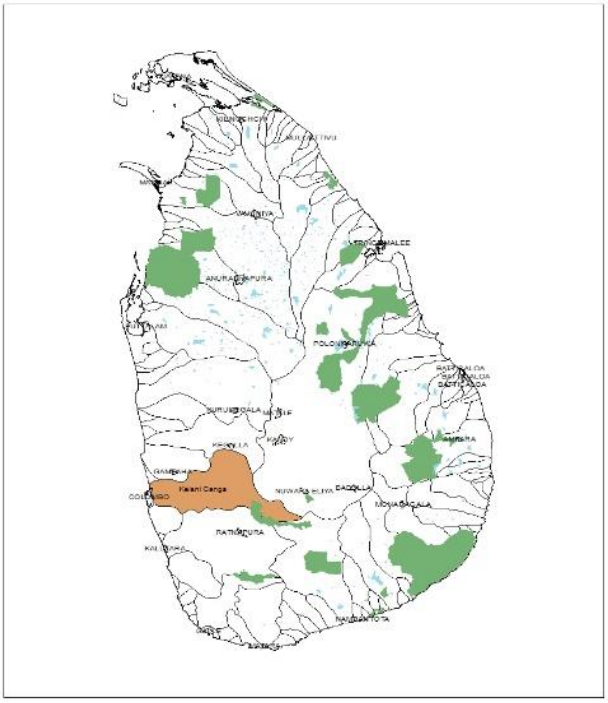
A key component of groundwater assessment and protection planning and implementation is to complete a regional/drainage basin scale groundwater characterization study compiling base line data to gain a better understanding of the subsurface conditions and threats and impacts on groundwater systems. This study is a part of the project on "Medium to Long term Multi-Sector , Multi stake holder Strategy and action plan for Management and Conservation of the Keleni River Basin" where the groundwater plays a vital role as it is a key component of the basin Management Study. The concept of Kelaniriver Multi-stakeholder Partnership (KRMP) will include a common strategy with a long term action plan with specific roles and responsibilities delegated stakeholders and other agencies. Further non-government stakeholder groups together with the industry, communities, school children and others are also to be considered during the time of strategy development.

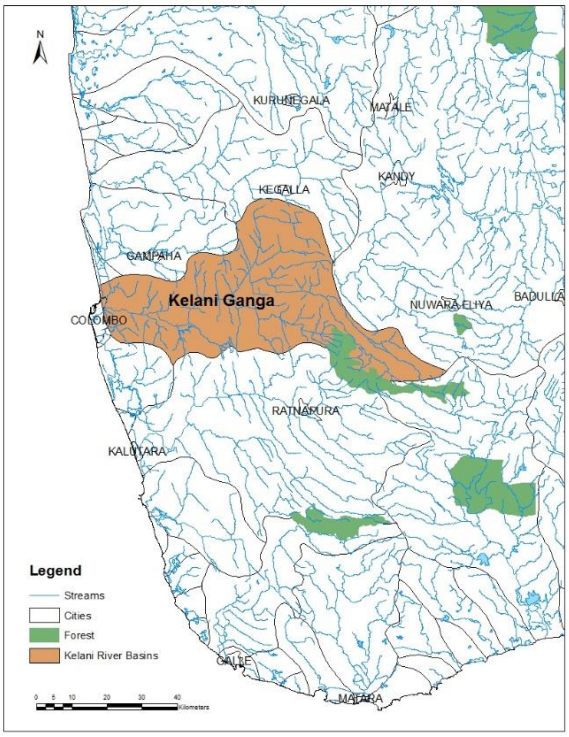
It has been noted that KelaniRiver basin is the home to more than 25% of Sri Lankan,it is obvious that the majority of people use groundwater for drinking and agricultural purposes leaving a romthat indicates the vulnerability towards the aquifer deterioration in terms of quality of quantity.

Study area

Kelani River, having the total length of 145 km and 2292 sq km of river basin is the second largest watershed and it is the most polluted river in Sri Lanka due to rapid growth of industries located in close vicinity of the river and passes through the country through most populated capital city.

The main sources of water pollution in Kelani river is the land based sources such as treated and untreated industrial effluents, agricultural runoff, domestic and municipal effluents. The gravity of water pollution is apparent when examining water quality measurements of Kelani River, which meets a major part of the demand for pipe borne drinking water supplies of Colombo. Kelani River is an important source of drinking water for the Colombo District and there is a water supply intake point at Ambatale, 14 kilometers from the river mouth. However, sewage from low-income settlements and industrial effluents (especially from tanning and metal finishing and processing industries) from a large number of industries are discharged conveniently to the Kelani River.





Terms of reference

Groundwater basin management requires fundamental information on the system hydrogeology. Sensible management of the groundwater basin in the absence of such information would be equivalent to attempting to manage a surface water reservoir without information on the reservoir geometry, location, flow rates, and sources and transport of contaminants. The TOR in the following are recommended for implementation at the basin level district level and could be incorporated into multi-Sector program as the action plan for groundwater management.

Figure: Kelani River Basin

The study will be completed in accordance with the TOR given below which will provide advice on the technical analysis of the compiled geological and hydrogeological data sets of the basin.

I. Assessment of groundwater resources and aquifer characterization
II. Development of artificial recharge plan
III. Groundwater intrinsic susceptibility analysis
IV. Groundwater assessment
V. Groundwater use assessment
VI. Potential contaminant sources inventory
VII. Groundwater management and protection strategy
VIII. Development of action plan to protect groundwater

Scope of work

Assessment groundwater resources and aquifer characterization:

Collection of available data

- Topography : use of digital elevation model (DEM)
- Surface water features
- Geology: Surficial and bedrock geology
- Hydrogeology
- Hydrological data
- Meteorological data

Collection of available data to develop a conceptual picture of the groundwater resources of the basin. The primary hydrogeologic data will be obtained from the water well information systems of Water Resources Board and National water supply and Drainage board. Data will be compiled in rational database and interpreted by hydrogeologists with the aid of GIS to develop a conceptual geological model at basin scale. On the basis of these data drilling and aquifer testing program will be conducted across the basin to update the rational data base.

Activities to be conducted to be filled data gaps:

- Hydrogeological Investigation for identification of new sites
- Geophysical 2D and ID resistivity techniques. Geophysical logs provide high quality information on the hydrostratigraphy. Characterizing the hydrostratigraphy with only driller's descriptive logs rather than geophysical logs is problematic.
- Groundwater and surface water sampling for water quality analysis
- Drilling and pump testing
- Down the hole geophysics to identify well lithology.

Development of artificial recharge master plan

- Identification of water areas with scarcity of water
- Evaluation of aquifer properties i.e. Aquifer parameter, aquifer thickness
- Assessment of metrological conditions

Groundwater intrinsic Susceptibility analysis

- Contaminant source/s identification
- Identification of Industrial ventures and their effluents
- Subsurface conditions that favors distribution of contaminants
- Preparation of aquifer vulnerable maps

Groundwater assessment

- Preparation of Hydrogeological map: Aquifer/Aquiclude/aquitard
- Assessment of spatial variability of water quality in both vertical and horizontal across the basin.

Groundwater use assessment

- Type and nature of water supply schemes
- Agriculture use: Land use pattern

Potential contaminant sources inventory

- Categorization of contaminants such as organic, Hydrocarbon and inorganic ect.
- Assessment of possible impacts/type of impact
- Identification of point and non - point contaminant sources: Active landfills, Agriculture practices

Groundwater management and protection strategy

- Recognition of potential and vulnerable places
- Contaminant source survey and establishment of ground water monitoring network.
- Identification of areas having impacts due to mining

Development of groundwater numerical model

- Assessment of existing data
- Identification of data gaps
- Development of physical conceptual model
- Drilling and aquifer testing to fill gaps where adequate data is not available

Work program:

Work program has been scheduled to go for 5 years that will develop a groundwater numerical model for the basin. This program is a tentative one so adjustments can be done as per requirements.

				Year				
No	**Item**		**Tasks**	**1**	**2**	**3**	**4**	**5**
1	Assessment groundwater resources and aquifer characterization:	Desk study	**Collection of available data** ▪ Topography : use of digital elevation model (DEM) ▪ Surface water features ▪ Geology : Surficial and bedrock geology ▪ Hydrogeology ▪ Hydrological data ▪ Meteorological data					
		Field activities	▪ Hydrogeological Investigation for identification of new sites ▪ Geophysical 2D and ID resistivity techniques. Geophysical logs provide high quality information on the hydrostratigraphy. Characterizing the hydrostratigraphy with only drillers descriptive logs rather than geophysical logs is problematic. ▪ Groundwater and surface water sampling for water quality analysis ▪ Drilling and pump testing ▪ Down the hole geophysics to identify well lithology.					
2	Development of artificial recharge master plan		Identification of water areas with scarcity of water ▪ Evaluation of aquifer properties i.e. Aquifer parameter, aquifer thickness ▪ Assessment of metrological conditions					
3	Groundwater intrinsic Susceptibility analysis		▪ Contaminant source/s identification ▪ Identification of Industrial ventures and their effluents ▪ Subsurface conditions that favors distribution of contaminants ▪ Preparation of aquifer vulnerable maps					
4	Groundwater assessment		▪ Preparation of Hydrogeological map: Aquifer/Aquiclude/aquitard ▪ Assessment of spatial variability of water quality in both vertical and horizontal across the basin.					
5	Groundwater use assessment		▪ Type and nature of water supply Schemes ▪ Agriculture use: Land use pattern					
6	Potential contaminant sources inventory		• Categorization of contaminants such as organic, Hydrocarbon and inorganic ect. • Assessment of possible impacts / type of impact • Identification of point and non – point contaminant sources: Active landfills, Agriculture practices					

7	Groundwater management and protection strategy		• Recognition of potential and vulnerable places • Contaminant source survey and establishment of ground water monitoring network. • Identification of areas having impacts due to mining					
8	Development of groundwater numerical model		• Assessment of existing data • Identification of data gaps • Development of physical conceptual model • Drilling and aquifer testing to fill gaps where adequate data is not available					

Estimate

Item	Description	QTY	Total (Rs million)
1	Drilling (Bore holes)	100	40.00
2	Pump Testing	20	2.00
3	Levelling	200	0.50
4	Chemical analysis (Chemical / bacteriological / heavy metals)	100	5.00
4	Numerical groundwater Model development		0.50
5	Establishment of automated groundwater network		5.00
5	Miscellaneous		0.50
		Total	**53.50**

The vat 11% should be added to the total estimate.

Terms of reference (TOR) for Pesticide and Hazardous Waste Management in Kelani River Basin
National Aquatic Resource Research and Development Agency (NARA)

General Background

Water quality of receiving water bodies such as rivers and lakes is critically important because it is one of the most essential resources for human existence and settlement. In particular, Kelani River is one of the important rivers which provides drinking water for 25% of the Sri Lankan population. However, rapid growth of population and increase of urban activities significantly influences the water quality of receiving water bodies. This is mainly due to the higher pollutant loads resulting from various point and non-point sources of pollution.

In particular, Sri Lanka is facing the serious problems of pesticides pollution. With the changers of agricultural practices to modern techniques, application of pesticides increased. Furthermore, farmers mostly misuse or overuse recommended dose of pesticides in the country. In relations to the pesticide import, the law and order is very weak due to many influences and lack of knowledge on pesticide certification based on its toxicity. Presently, pesticide pollution has impacted on the human health in the Northeastern province and may extend to other provinces in future. Therefore, in relation to the toxicant management, prevention is very important rather than removal of toxicant from the polluted water sources. However requirement of the risk assessment and field observation and laboratory analysis are the important actions to be implemented during the management process of the river basin management.

Objectives

- To identify the threat of pesticide in Kelani River basin
- Quantification of the pesticide pollution in river basin
- Increase awareness among general public on importance of water quality management
- Influence on waste disposal regulation in western province

Main activities of the TOR:

1. Influence on public on the importance of the proper disposal and minimal use of toxic chemicals in the country by using mass media (as TV programme/discussion, Impressive advertisement) in every TV channel
    a. Inform to the relevant agency
    b. Find suitable expertise on the issues
    c. Implement with the support of the funding agency

2. Identification of the possible threats of pollution in the basin by literature survey and field observation

    a. Use of research literature
    b. Collect information from the stakeholders
    c. Field inspection

3. Test for possible pesticides and their metabolites in the river water in each season
    a. Setting up relevant research team
    b. Establish instrument setup to analysis of pesticides and their metabolites- Gas Chromatography Mass Spectrum MS and its accessories

c. Gathering of the knowledge on analysis and effective mediation of accurate analysis protocols among relevant stakeholders
d. Collection of samples and transport with necessary care
e. Testing with GCMS
f. Capacity building in the laboratory to test toxicant consequence on human health using animal models

4. Imposed regulations on critical polluters in the river basin or suggest possible remedial measures
    a. Identification
    b. Discussion with them and improve awareness
    c. Regulate with possible measures

5. Increase awareness among politician and relevant government officers on risk of pollution and implication on human health
    a. Make awareness workshop to political body involved in this fields
    b. Support to necessary changes in the legal framework on these matters
    c. Get approved by the parliament

6. Influence to the relevant agency on construction of hazardous waste disposal system in western province
    a. Discussion with agencies
    b. Identify possible locations
    c. Get approvals from the parliament
    d. Award to contract to developers to with relevant institutional and expertise support

In order to achieve above, technical and material support should be granted to the relevant stake holders by the funding agencies or the government as national priorities.

Output and expectation

- Minimization of the pesticide pollution in Kelani River basin
- Ensure proper disposal of hazardous waste in western province
- Minimization of toxic chemical use in the catchment by participatory approach
- Ensured educated public on water pollution and its impact on human health

Budget for the TOR

Findings need to be identified for each activity separately. Therefore, it may need further clarification how this will be implemented in future.

Time frame

Estimated time period is three years. Activities may be prioritized based on the requirements and funds. Please note that the required time may vary with the institutional, political support and work programme priorities of relevant agencies.

Contact:

Dr. Niroshana Wickramaarachchi, Senior Scientist, Environmental Studies Division, NARA

Terms of Reference for Detail Biodiversity Assessment for Kelani River Basin

IUCN Sri Lanka

Rationale

Most natural resource management practices have been based on the administrative boundary system, which divides the given geographical location according to historical artificial divisions. Such an administrative system does not give significant attention to natural factors which are readily important to sustainable management of natural resources. Given this, several other concepts have been introduced to facilitate better natural resource management. Management practices which are based on mountain ranges, landscape approaches, ecosystem approaches and river basins are some of the management initiatives that do pay significant attention to natural boundaries rather than artificial administrative boundaries. The Mahawali Development Authority, the special area management plan for coastal area management and the Hantana mountain range environmentally sensitive area of the CEA are examples of such initiatives.

Although such initiatives do pay attention to the natural boundaries which are mostly important to such systems and locations, they consider only selected aspect/s that are covered by their official mandates and therefore their decision making process is not fully participatory. Thus, most of the time, some of the key stakeholders are excluded from such management processes, even though they are concerned with natural resource management.

The Kelani River, the fourth longest river (145km) in the country, is one of the most important river basins in Sri Lanka from an economic, social, cultural and environmental as well as biodiversity perspective. Its basin area extends 2292 km^2 across the Colombo, Gampaha, Kegalle, Rathnapura and Nuwaraeliya districts. Further, the Kelani River basin has been divided to 20 mini watersheds (Department of Agrarian Development, 2011).

The Central Environmental Authority is laying the foundation to develop a project for a medium to long-term, multi-sector, multi-agency and multi-stakeholder strategy and action plan for the conservation and management of the Kelani river basin. This project will contribute to conserving and ensuring the sustainable use of natural resources in the Kelani river basin and furthermore will provide a replicable model that can be adopted at the national and regional level.

Firstly, It is vital to understand the present status of biodiversity in the Kelani River basin in order to understand the complex nature of the ecosystem services of the entire basin. Such information together with issues and opportunities are vital to conserve and ensure sustainable use of natural resources in the basin. According to the published information, there is no comprehensive publication on biodiversity, environmental issues and usage of natural resources of this area, besides several ad-hoc research works. Therefore, the proposed rapid biodiversity assessment will contribute to filling the knowledge gap which is needed to design a technically sound river basin management project.

Objectives

To prepare a baseline biodiversity profile for the Kelani river basin.

Expected Output

Biodiversity status profile for the Kelani river basin which includes:

Fauna, flora, major ecosystem/habitat types, usage of natural resources (as preliminary observations) and threats to biodiversity and environment of the area (as preliminary observations).

Furthermore, recommendations for sustainable use of natural resources will be incorporated at the preliminary level.

See Annex 01 for the outline of the report

Duration

2 years

Estimated budget

Rs. 6 mn

Proposed Activities and Methodology

(i) Literature survey

A literature survey covering biological, ecological, socio-economic and cultural information regarding the Kelani river basin will be carried out at the commencement of the project.

(ii) Field survey

A field survey will be conducted in order to collect data on biodiversity of the Kelani river basin using the following steps. Please see the annex 02 for expanded methodology of rapid biodiversity assessment.

- Conduct a detail biodiversity survey; which includes
  - Preparing an inventory of all vertebrate and selected invertebrate groups of the Kelani Basin;
  - Preparing an inventory floral species
  - Preparing an inventory of vegetation/habitat types of the Kelani Basin
- Identify the main uses of biodiversity and environmental products in the area
- Identify the major threats to the environment and biodiversity of the area
- Record any other relevant information

Since the project area extends the entire length of the 145 km long main kelani river and across several other sub catchments (including the Wak oya, Gurugoda Oya, Sithawaka Oya, We-Oya, Maskeliya Oya and Kehelgamuwa Oya sub catchments), sampling points will be selected to cover the entire river basin and to represent all major ecosystems/habitat types. The following sub sampling segments have been identified to facilitate the rapid assessment methodology. Five day field visits will be allocated for each sub segments.

1. Lower part of Kelani river – From the river mouth to Awissawella, including the Wak Oya sub catchment
2. Sithawaka sub catchment
3. Gurugoda Oya and Wee Oya sub catchments
4. Upper Kelani river (main Kelani river from Awissawella up to Maskeliya and Kehelgamu oya)

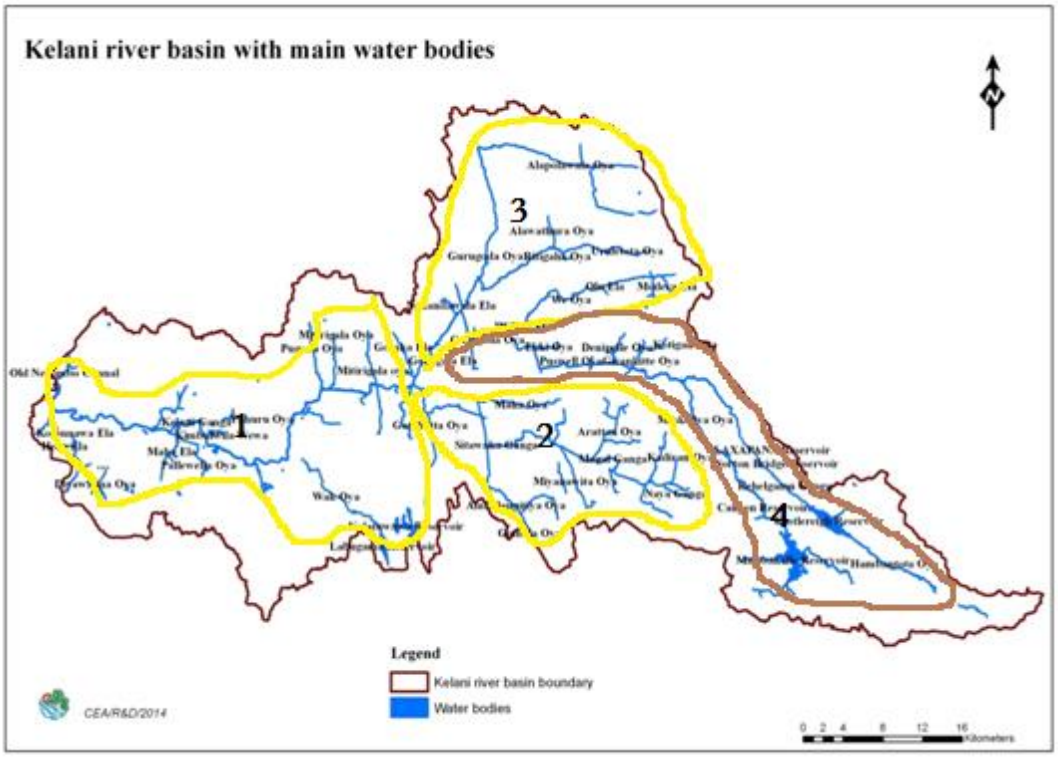


Figure - Map of the Kelani river basin with main sampling segments

(iii) Compilation of findings from the literature survey and field survey

Once the team returns from the field, the findings of the literature survey and field survey will be compiled and presented in the IUCN standard report format.

Annex 01: Outline of the Biodiversity status report for Kelani River Basin

Executive summary
Introduction
Objectives
Methodology
Results

- Status of Biodiversity of the Kelani River Basin
    1. Vegetation/Habitat types
    2. Flora
    3. Fauna
- Environmental issues and threats to biodiversity in the Kelani River Basin
- Current and potential uses of natural resources of the basin with special emphasis on biodiversity

Discussion
References
Annexes

Annex 02: Proposed methodology biodiversity assessment

The choice of methods will be utilized for any particular sampling programme is dependent on its goals. In this case, main objective is to rapidly identify and document plants and animals present in the area of Kelani River basin. The floral sampling will be designed to document the existing forest composition, structure, and species richness that will be used as a baseline for dissection making tool. The fauna sampling will be designed to understand the species richness within the identified ecosystems.

Biodiversity survey

Floral sampling methods: The detail survey will be planned according to the ground situation examined. Different life forms covering herbs, shrubs and trees were documented using different sampling intensities to yield the best available floristic information in line with available time, resources and level of representation of different vegetation types. It should be noted that sometimes the younger stages of some tree species/shrub species were recorded as herbs showing the actual life form represented during the time of observation.

Taxonomic identification of plants will be made according to standard botanical techniques. References mentioned at the end will be extensively used. The plant species will be identified and classified using the latest standard published guides and keys available in Sri Lanka. Some of the key references that will be used to identify plants are given in Table 1.

Table 1. Key references will be used for flora identification

Group	Sources
For Invasive species	MoE (2015)
For Taxonomic identification	Ashton *et al.* (1997); Dassanayake & Fosberg (1980 - 1991); Dassanayake *et al.* (1994 - 1995); Dassanayake & Clayton (1996 - 1999), de Vlas & Jong (2008)
Nomenclature	Senaratne (2001); Rajatewa (2014)

Faunal sampling methods: Sampling of fauna will be planned simultaneously with floral sampling sites. Visual Encounter Survey (VES) was the main method used for faunal survey and was done during both day time and night time (where it can be possible) to record the faunal species present in the sampling site. During the night sampling session tree holes, termite hills and tree tops will be also searched using a head mounted torch. Freshwater fish species will be observed from the stream bank as well as snorkeling. Fish species will be caught using hand nets to take photographs and released in to the same location. Photographs will be taken putting them in to small glass tank.

Both direct and indirect observations (animal signs such as pellets, tracks and food remains) will be used in identifying animals present within the study area. The identification and classification of faunal species will be based on the most recently published field guides and taxonomic keys (see Table 2).

Table 2. Key references will be used for identification of fauna

Literature Types	Group	Reference Source
	IAS Fauna	MoE (2015)
Taxonomic identification	Land snails	Naggs & Raheem (2000)
	Dragonflies	Bedjanic *et al.* (2007); Bedjanic *et al.* (2014)
	Butterflies	D' Abrera (1998)
	Fishes	Goonatilake (2007), De Silva *et al.*, (2015)
	Amphibians	Manamendra-arachchi & Pethiyagoda (2006)
	Reptiles	Somaweera (2006); Somaweera & Somaweera (2009)
	Birds	Harrison (1999); Warakagoda *et al.*, (2012)
	Mammals	Kotagama & Goonatailake, (2013)

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Preliminary Ideas for Application of Economics Tools in Kelani River Basin Management and Conservation

IUCN

Kelani river originates in the central hills and runs through Central, Sabaragamuwa and Western Provinces before emptying its waters to the sea near Mutwal in Colombo. In its approximate 145km journey, it provides numerous goods and services to the people in the Kelani river basin and beyond. Some of these goods and services can be categorized as **source**s of materials for either direct consumption or for production processors –water and sand. The Kelani river also acts as a sink by absorbing waste materials and making them non/less harmful to human and other living beings within the capacity of the river to handle them. The river also regulates the quality and quantity of water with its watershed characteristics. These source, sink and regulatory functions of the river provides many millions of people in the basin and beyond immense economic benefits. They all comes as benefits of river ecosystem, if the river basin is properly managed these benefits will be generated perpetually as ecosystem goods and services of the river basin. Hence the river basin can be considered as a part of natural capital, if maintained properly it will continue to provide the dividends-ecosystem goods services with no cost to the beneficiaries.

River basins being common pool resources, the users are generally trying to maximize their individual benefits and pay least attention to the wise use or sustainable use of the resources. Further some of the uses are conflicting – releasing of industrial effluent into the river beyond its assimilative capacity and extraction of drinking water, diverting of river water for hydropower and impact on water based tourism activities immediate downstream of such diversions and excessive sand mining and seawater intrusion are some examples of conflicting uses. Furthermore, some are destroying the components of the river basins such as watershed areas threatening the functionality of the complex ecosystem, which will have long term implications for provisioning, regulating and supporting services of this vital natural capital which KRB provides at no cost to the society. For instance, in an extreme case, if the Kelani river is polluted beyond it could no longer be suitable to supply drinking water. The alternative sources of drinking water has to be found, additional cost of providing drinking water from such a source can be considered as the lower bound value of ecosystem services provisioning of clean water by Kelani river. We see some signs of KRB being ‘stressed’ and struggling to continue the provisioning the services that it has been given since time immemorial. If not these are handled now it will be too late to act.

The discipline of economics is capable in analyzing such conflicting situations and providing guidance to decision-makers to take more informed decisions before it is too late for taking correct decisions. Therefore, it is recommended that application of economics tools be considered to the extent possible in formulating the strategy and action plan for the management and conservation of Kelani river basin.

In addition to what we observe in resource use, climate change induced changes are expected to aggravate the situation. Well functional rivers will be more resilient to disasters, safeguarding communities in the basin from disruption of the normal functioning of the society with life losses, damages to assets and economic and environmental losses. Hence, avoided damages and losses also can be considered in assessing economic benefit of r managing and conserving Kalani River Basin on its resilience.

Broad areas are listed below for wider discussion with stakeholders for prioritization and implementation in Kelani basin during the next phase of the project.

1. Economic characterization of the economic value of ecosystem services in Kelani river basin with a disaster sentivity. Estimate what Kelani contributes to the GDP of Sri Lanka through its ecosystem goods and services.

2. Demonstrate the economic rationale for investing in Kelani basin as part of disaster sensitive natural capital. This would include considering the Kelani basin as part of water infrastructure.

3. Identification of market based instruments for sustaining ecosystem service benefits of Kelani river while increasing resilience. Both incentives and disincentives to be identified to encourage conservation action and to discourage pollution/over extraction beyond limits. Payment for ecosystem services as a pilot study.

4. Identification of innovative financing mechanisms including payment for ecosystem services (PES) for implementation of the strategy and action plan for the management and conservation of Kelani river basin.

Next step

Developing a comprehensive TOR with work palns for the above key areas

Time frame

Time frame for developing a comprehensive TORs with work plans for the above key area identified: January 2016-July 2016

Estimated budget

Rs.1 mn

Terms of Reference for Land use planning in the Kelani River Basin

Land Use Policy Planning Department (LUPPD)

Scope of the Study

As a result of the rapid urbanization, population increase and infrastructure development in the Kelani River Basin, environmental pollution is a growing issue. This leads to river water pollution in one hand and Land degradation on the other.

For instance, water quality analysis shows that some chemical compositions are presently exceeding the expected Levels. It is also observed that large number of Industrial effluents are being discharged to the Kelani River without any purification. There are instances also in upper reaches of the basin is subjected to heavy soil erosion due to poor crop management and inappropriate land uses.

Therefore, in detail study of the land uses and land use planning for the entire Kelani River Basin is very necessary to formulate mitigatory plans.

Proposed activities

1. Develop Detailed Land Use and Environmental Pollution/Conservation Related Data Bases for 20 Sub-watersheds of Kelani River Basin.
2. Prepare sub-watershed basis land use plans for above 20 sub-watersheds.
3. Develop Mitigatory Plans for most critical and degraded sub-watersheds.
4. Identify areas where soil conservation is necessary in agriculture sector both plantation and farm household level.
5. Form “Catchment Protection Committees” for Critical micro-catchments according to the severity of land degradation.
6. Create awareness and provide training for most vulnerable groups among the members of such (above) committees.
7. Determine riverbank areas where the biological restoration of stream reservations are needed and practical.
8. Prepare Demonstrative /Conservation Plans for Selected Farm Plots/Land Parcels.
9. Conduct Motivation Programs for (above) Small Farmer Groups through incentive programs for soil and moisture conservation in selected farm plots.
10. Develop suitable agro-forestry systems for appropriate locations where the forest cover/tree Cover is to be enhanced/ enriched.
11. Determine suitable institutional arrangements for the areas where industrial pollution is leading to water pollution in the lower reaches of the KRB.

    Estimated budget; Rs.14 mn.

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