



## 'Innovations for Resilient Environment' - NBRO holds 6th Annual Symposium 2015

6th Annual Symposium of National Building Research Organisation - 'Innovations for Resilient Environment' was held on Tuesday, 22nd December 2015 at the Auditorium of Ministry of Disaster Management.

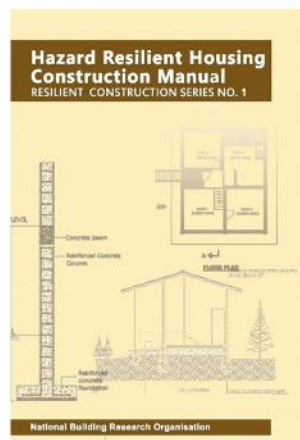
At the Inaugural session Dr. (Eng.) Asiri Karunawardena, Director General, NBRO delivered the welcome address of the symposium. He also talked about the present status of NBRO and introduced the purpose of the symposium. Then, Prof. Ajith De Alwis Project Director, COSTI delivered the keynote address, "Innovations for Resilient Environment" a very interesting presentation relating innovations to resilience. Then the Guest of Honour, Mr. S. S. Miyanawala Secretary of Ministry of Disaster Management addressed the audience. The launching of the book "Hazard Resilient Housing Construction Manual" took place afterwards which was followed with the Award Ceremony where all the presenters were awarded with certificates of appreciation and Ms. Ramani Jayampathi of NBRO was awarded for her outstanding performance in winning the competition "Dhadiya Siththama".

The symposium had three structured technical sessions comprising of the following; Guiding towards resilient development; Engineering innovation, and Best practices. These sessions were chaired by Plnr. Archt. Veranjan Kurukulasuriya, Director General, NPPD, Dr. Gamini Jayathissa, Senior Scientist, NBRO and Prof. Ranjith Dissanayake, Head, Dept. of Civil Engineering, University of Peradeniya, respectively.

At the end of symposium, a panel discussion was held and panel was chaired by Eng. (Dr.) Asiri Karunawardena, Director General, NBRO. Plnr. Archt. Veranjan Kurukulasuriya, Prof. Ranjith Dissanayake, and Mr. RMS Bandara, Director, Landslide Research & Risk Management Division participated as panelists while Eng. Clarence Perera, Consultant of NBRO served as the Moderator.



## NBRO launched the Hazard Resilient Housing Construction Manual



NBRO launched the Hazard Resilient Housing Construction Manual on 22nd December 2015 at the Research and Development Symposium 2015 at the Ministry of Disaster Management. The manual provides ample guidance and advice by sharing the experiences and expertise available in Sri Lanka and in the world. That is the first of a series of Resilient Construction Manuals that is intended to serve the professionals, practitioners and

the laymen who may want to safeguard their house by adding simple, but engineered solutions. This Manual has been developed to promote the use of hazard resilient engineering design and construction practices when building houses in Sri Lanka. The goal of the manual is to develop a culture of hazard resilience among house builders through basic engineering practices. Furthermore, it attempts to inculcate among the communities the adaptation of safer building construction practices especially when constructing in areas identified as disaster prone. The Manual focuses on the fact that housing environment is better prepared for potential disaster events through proper planning, siting, design and construction practices.

The primary aim of this Manual is to minimize the risk associated with individual houses built in natural hazard prone localities as much as possible. Also, it aims to minimize the damage to at least some structural elements, if not all elements of the house during an extreme event, so that people can resume their day-to-day activities without much interruption. The Manual mainly focuses on construction of a single or two storey house having a floor area of not more than 80 m<sup>2</sup>. It attempts to address specific issues associated in the construction of housing in areas prone to specific natural hazards, namely, landslides, high winds, floods, tsunamis and earthquakes or in areas exposed to inherent problematic ground conditions that could be hazardous to be built therein. This Manual also aims at providing as much technical information as possible in a single reference material that brings together the relevant previously published disaster specific construction guidelines and additional engineering measures that have been adopted recently through research and practice.



National Building Research Organisation

# N Newsletter

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## Dear Readers

We are happy to welcome you again to read the first issue of NBRO Newsletter in the year 2016. This presents myriad of articles on NBRO's achievements, present activities and future plans. Notably the article on finding the root cause of ground tremors felt in Achchuweli in Jaffna peninsula using state of the art Ground Penetration Radar (GPR) equipment is very intriguing. One fascinating article is on snakes in Sri Lanka and yet another is on feminism, the two articles adding new dimensions to our newsletter. Cartoons - a new feature in the newsletter will be the most exciting item of all. We sincerely hope that the readers will enjoy reading this edition of newsletter. We welcome your feedback and ideas submission for inclusion.

2015 has been a very successful year for NBRO with many accomplishments. Having completed the assigned responsibilities and duties with diligence and having completed most of landslide mitigation projects, NBRO also earned a significantly high revenue in 2015. The Research & Development Programme was another successful and significant breakthrough.

The Annual NBRO Research Symposium was held at the end of the year and nearly 31 technical papers were published in the Symposium Proceedings. The Hazard Resilient Housing Construction Manual prepared by NBRO was launched at the Symposium.

Year 2106 is expected to be another eventful year for NBRO. Research and Development programme of 2016 has been started already and the accreditation of NBRO laboratories is underway. The Deputy Minister of Disaster Management Hon Dunesh Gankanda launched the Construction Project of new Laboratory and Office Building Complex for NBRO on 24th March. The five storey building complex with modern testing laboratories will be complete in two years' time and we are hopeful that with the new facilities NBRO would be able to serve clients and the general public better.

Best Wishes,  
(Eng.) Dr. Asiri Karunawardane  
Director General, NBRO

National Building Research Organisation (NBRO), a premier research & development institute which was established in 1984 has now grown into a successful technical service provider and research and development institution where experts from multiple disciplines have teamed up and dedicated to create a disaster free safe environment for the nation.

NBRO is the national focal point for all landslide related studies and services in Sri Lanka. In addition, the NBRO's expertise extends into a wide range of disciplines such as environmental science, human settlement planning, engineering project management, geotechnical engineering, and building materials engineering also. Over the years NBRO has developed her capacity to become

a competent research institution in Sri Lanka and at present NBRO serves as the research arm of the Ministry of Disaster Management.

NBRO recognizes the diversity of the problems faced by the nation in their living environment, and is geared up to achieve suitable solutions to maintain and improve the high quality of life.

Objectives of NBRO have been revised to cater the mandate of the ministry of Disaster Management. All the activities are redesigned focusing the main objective of 'Disaster Risk Reduction'. NBRO heavily relies on self-earning and most of her financial resources are generated through consultancy & testing services offered to the state and the private sector.

## Horizontal Gravity Drains (HGD) at Punchi Raththota Landslide

By M.D. Suranga

Landslides can result in enormous casualties and huge economic losses in mountainous regions. In order to mitigate landslide hazard effectively, new methodologies are required.

For the purpose of reducing risk at the Punchi Raththota landslide in Matale district: which is situated in a highly populated area, the Geotechnical Engineering Division of National Building Research Organisation is constructing Horizontal Gravity Drains (HGD) as a mitigation measure decided through a detailed engineering design. Initially it was planned to construct four radially distributing sets of drains (each having seven numbers of HGD with 30m length).

Due to many difficulties, the field team was able to complete only two sets denoted as DS-3 and DS-01. Currently, constructing of DS-04 is progressing well. It was noted that the rate of water flow is negligible at DS-01 and DS-03, as the area exhibits dry weather condition at present. However, at the 1st drain of the DS-04 has been very successful, where the rate of water flow has reached 17 l/min at present.

Installation of HGD was found to be an effective mitigation measures. Therefore, the organization plans to incorporate HGDs to lower ground water levels at critical landslides to minimize the landslide risk in the future.

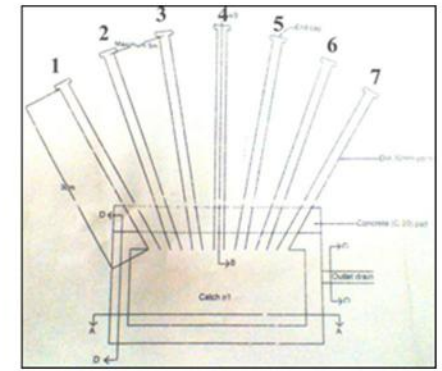


Fig. 1: Schematic diagram of a Set of Horizontal Gravity Drains



Fig. 2 Water flowing out from the HGD-5 at DS-01 at Punchi Raththota landslide site to lower the ground water level

## The Role of Feminism in Conserving the Nature

By Thushani Seneviratne

**Feminism** is often demonized and considered as a radical approach in most of the societies and it happens even in the modern societies to a certain level. Often society idols and leaders tip toe around the subject of feminism in public statements in fear of being branded as radicals in the conservative societies. Still it is not hard science to understand the marginalized role of female counterparts in the game of conserving the nature, considering the palliative role the female members of the society played from the very beginning of our mankind.

From hunter-gatherer to modern urban lifestyle, women have been playing the role of primary caretakers of families. Their role as primary stewards and principal users of the natural resources is largely unrecognized and often overlooked in majority of conservation efforts around the world. Even though in the Rio Declaration Principle 2, it is recognized that women have a vital role in environmental management and development and their full participation is essential to achieve sustainable development, it is stupendous to note that women represent less than 25 percent of the leadership positions in the conservation sector. And it is also noted in many studies that large part of women participation in conservation sector involves fundraising but not in conservation governance. When looking beyond the gendered knowledge which privileges the masculine over the feminine, the systematic engagement of women in conservation efforts especially in conservation governance is crucial as women deals with natural resources as a part of their daily chores may it be fetching water, gathering fuel wood, etc., and they are the most affected ones in the environmental degradation as well. For instance, women are more vulnerable to climate change as women make up the largest share in the agricultural work force around the world and they are often

limited by their mobility in sudden weather-related natural disasters which makes them more vulnerable.

Often with fewer income generating opportunities around, women are forced to work harder to secure the food, water and energy flow to their households even in extreme weather conditions. Young girls are often forced to drop out of school rather than their male siblings. Nevertheless, females have proven their metal as the agents of change more than few times in the history of environmental movements. Chipko movement is one of them. The chipko movement of India started in 1906 is one such non-violent movement organized by an all women group which eventually became the first model for future environmental movements. Female village activists participated in this non-violence movement against the deforestation in masses, in a time where the environmental movements were not heard of or practiced in developing world. Even though the success of this movement inspired many such campaigns later on, low female participation in environmental protection and management, formulation, planning and execution of environmental policies coupled with male monopoly is still seen in the global environmental platforms. Providing more access to resources, information, education and training leading to higher level of management and technical skills among women will eliminate this under representation in future generation.

In an era where conserving nature and its resources is a matter of life and death as more people bemoan and vie the paucity of natural resources, advancing feminist approaches might be the solution in fixing our earth without sticking into the same old conservation strategies.

NBRO

99/1, Jawatta Road, Colombo 5, Sri Lanka  
Tel: (+94) 011 2588946, (+94) 011 2503826

## Editorial Committee

Kishan Sugathapala  
Director, Human Settlement Planning and Training Division

Clarence Perera  
Consultant, R & D Programme, NBRO

Eshi Eranga Wijegunaratna  
Scientist, Human Settlement Planning and Training Division

### Cover Photograph

Opening Ceremony of new NBRO Laboratory complex and office building complex.  
Photo captured by Chenenka Liyanapathirana.

## Cartoon Collection







NBRO's Association of Professionals (AOP) held an Annual Event and AGM 2015 on Wednesday, 3rd February 2016 at Pegasus Reef Hotel, Wattala.

AOP has provisions to operate under three major objectives; to promote and safeguard the interest of the NBRO, to promote and safeguard the interest, rights and privileges of its members and to enhance professional carrier development of members. This was highlighted in the Welcome Address delivered by Plnr. Chinthaka Rathnasiri, President of AOP, NBRO. After that, NBRO Professionals Speech was delivered by Dr. H.A.G. Jayathissa who is a member of the Executive Committee of the AOP.

## NBRO's Association of Professionals Annual Event & AGM 2015

Then, Eng. Dr. Asiri Karunawardena, Director General, NBRO and Dr. S. Amalanathan, Additional Secretary to the Ministry of Disaster Management addressed the gathering. The Keynote Address was delivered by Dr. Milinda Pathiraja, Senior Lecturer, Dep. of Architecture, University of Moratuwa.

Subsequently, the Awards Ceremony was held to award Senior Members who retired during last year. A Product Demonstration took place afterwards by the main sponsor Office Network (Pvt.).Ltd. Soil Tech (Pvt) Ltd then demonstrated their capabilities by a video presentation. Mr. Nishantha Kamaladasa, CEO, Distance Learning Centre Professional Development, delivered a lecture on Professional Development. Finally, Mr. B.V.P. Jayakody, Secretary, AOP delivered the Vote of Thanks.

AGM of the AOP was held during the Afternoon Session of the Event. Following the presentation of the AGM Reports of last year, the new committee members for the year 2016 were appointed. The event ended with a Networking Event for the AOP members.



## New NBRO Laboratory and Office Building Complex

Hon. Dunes Gankanda, Acting Minister of Disaster Management launched the project to construct the five storied new Laboratory and Office Building Complex in the NBRO Head Office premises at the auspicious time in the morning of Thursday, the 24th March of 2016, while the venerable Maha Sanga were chanting 'Seth Pirith'.

Mr. S. S. Miyanawala, Secretary of the Ministry of Disaster Management, together with the senior staff of the ministry, Directors General of the line agencies and members of the NBRO Interim Management Committee were present and most of the NBRO staff were in attendance to witness the happy moment. Eng. Dr. Asiri Karunawardena, Director General of NBRO welcomed the invitees and then both the Hon. Minister and the Secretary addressed the cheerful gathering.

Investment on the building complex is about Rs. 350 Mn. provided by the Govt. The technical divisions of NBRO will occupy the proposed building which will house the new laboratories of Geotechnical Engineering, Building Materials Research and Testing and Environmental Services and Studies divisions. Hence, in the near future, all these divisions will function in a high tech environment of the new facility. The design and construction of the proposed building complex will comply with environmentally friendly concepts such as green building, zero energy, and have disaster resilient features such as earthquake resistance. NBRO is hopeful of delivering its services to the nation in a more efficient and effective manner with the completion of the building in about two years time.



## Recent Land Subsidence in Achchuveli

On 23rd January 2016, people in Achchuveli area in Jaffna peninsula experienced a minor tremor. NBRO was requested to investigate this occurrence and a team from Landslide Research and Risk Management Division (LRRMD) of NBRO consisting of Mr. RMS Bandara, the Director, and the senior scientists, Dr. Pathmakumara Jayasingha, Mr. Laksiri Indrathilake and Mr. Chaminda Moremada was dispatched immediately to conduct the investigations. According to their findings the tremor was due to ground settling in a particular location in Achchuveli.

Cracks (1-5 cm) due to ground subsidence were observed in the ground within a circular area of approximately 70 m in diameter. The affected area is a farming land. A house on the perimeter of said circle was found to be severely cracked and slightly tilted. LRRMD geologists explored the area on 27th January 2016 and conducted a geophysical survey to understand the present subsurface ground condition of the affected area.

Geologically the area is composed of limestone, a weak sedimentary rock which is soluble. The formation of dissolution cavities and caverns are common in such terrains and in some parts of the Jaffna Peninsula, underground tunnels and cavities are found. The geophysical studies in the affected area revealed the occurrence of some underground discontinuities in the limestone terrain, indicating the presence of such underground cavities, possibly filled with water or soil moisture. Due to activation of such dissolution cavities, ground settling can be expected with time, leading to ground subsidence in the affected area.

People of the area were instructed to be on the alert and occupants of the affected house have already been evacuated. Further studies on this matter are presently continued.

## Geotechnical and Geological Characterization of Kahagalla Earth Slip

By W.A.D.T.L. Wijesinghe

The Kahagalla earth slip is a unique landslide. It is one of the sixteen proposed mitigation sites under the Landslide Disaster Protection Project (LDPP) in Sri Lanka. (This earth slip first occurred in 1957 located between Haputale and Bandarawela on Beragala-Hali-Ela highway A16 at an elevation of 1430 m above MSL). National Building Research Organization executed the geological and geotechnical investigation with an objective of introducing mitigation measures.

The Kahagalla earth slip is a soil mass moving at a rate of 20mm/year. The slip was characterized by circular type rotational failure and debris flow at the toe area. The soil is mainly dominated with coluvium and residual components. The slip was caused by pore water pressure due to the infiltrated water and water in the solution cavities and the slip surface is located at a depth of 15.8m. A mitigation program has been established based on the data from the geotechnical and geological investigations.

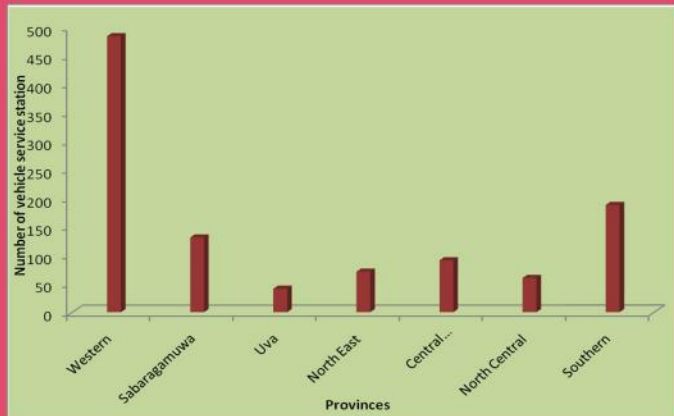


# Environment Pollution by Mismanaged Service Stations in Sri Lanka - A Case Study

By S Jayamanna

Service stations play an important role of keeping vehicles in the best of their conditions. As a result of increasing vehicle population which is due to the development of road network system and vehicle pricing policy system in Sri Lanka, there is an increase in the number of automobile service stations.

Following figure shows the number of service stations obtained Environmental Protection License (EPL) from the Central Environmental Authority during the period of 2001 to January 2010.



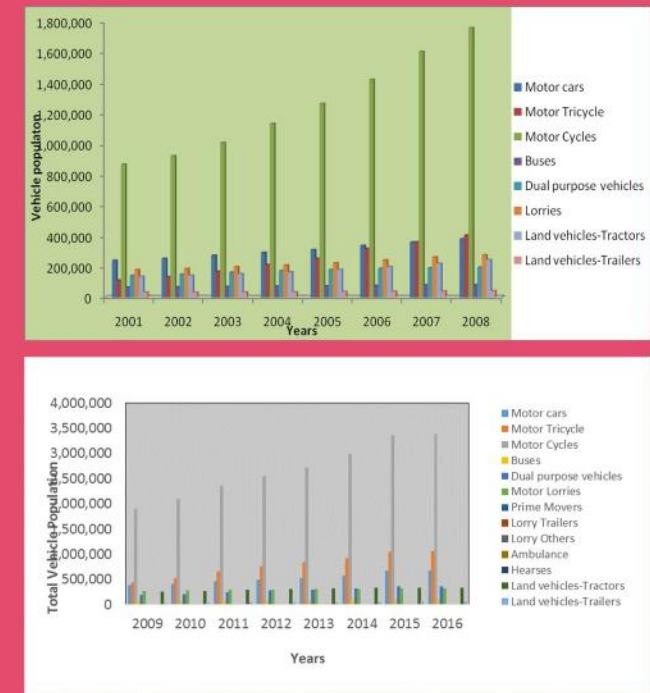
\*\*Figure 01: Number of vehicle service station in Sri Lanka  
\*\*Source: Central Environmental Authority

With the increase of vehicle population it is obvious that the automobile service stations are mushrooming at every nook and corner of the country as a business. Effluents from the vehicle service stations may cause air, water and soil pollution. For every vehicle wash petrol, kerosene oil, or diesel is used as cleaning media along with surfactants.

After washing, petrol, oil, diesel and greases all pollute the environment and contribute to Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and suspended solids in effluent waters. Fumes from petrol, diesel, solvents or greases are very dangerous. In sewers they reach into considerable volumes from street and service stations. Most of the oils floats on wastewater, although a portion is carried into the sludge on settling solids. Sludge from a carwash activity can clog drains and municipal sewers if it is not separated from wastewater stream from services station and disposed properly. Release of hazardous contaminants especially hydrocarbons, hazardous air pollutants (HAP) and volatile organic compounds (VOCs) from the underground storage tank, vent pipes, during decantation and petrol filling, contribute to air pollution.

The Environmental Studies and Services Division carried out a ground water monitoring programme in 2010 to study the water pollution by Oil and Grease from the service station in Western Province and identified the ground water contaminated by oil from mismanaged service stations.

Following figures show how the population of different classes of vehicles increased during the period from 2001 to 2008 and 2009 to 2016.



\*Figure-02: Vehicle Population (2001-2008 & 2009-2016)



Extracted Oil and Grease (Yellow colored)

Figure-04: Oil and Grease extracted from the ground water from a well close to a Vehicle Service Station

It is obvious that automobile vehicles need to be washed frequently to remove dust and preserve the aesthetic appeal and lastly but not least to increase their life span. In this connection it is imperative to conduct a programme to monitor service stations which are running without adhering to regulations and to point out the present practices adopted by the workers and potential impacts of these haphazard practices on lives of the workers and the environment. And also it is really important to address the possible hazards that these pollutants cause and suggest possible remedies and treatment options for such wastewater and select the best possible option.



## Kokmaduwa Landslide at 114 Km Post of Southern Expressway

By Chamodi Boyagoda

Sri Lanka lies in the monsoon region of South Asia. Kokmaduwa is situated in Southern Province of the island and experiences a tropical climate. As a result of heavy rainfall occurred during the period from 25th to 30th September 2015, a massive ground instability was observed on the left hand cut slope of the Southern Expressway at the 114 km post at Kokmaduwa. National Building Research Organisation (NBRO) provided consultancy services to Road Development Authority for applying short term mitigation measures and designing the long term mitigation measures for stabilization of the slope failure.

### Short term mitigation measures applied

1. Establishment of an Early Warning system was considered as a priority to lower the vulnerability of commuters in the Expressway and an extensometer was installed to send warning signals in the event of a potential slope failure.
2. According to the observations of lithology, hydrology, geomorphology, structural geology and soil type at the above landslide, the sudden increase of pore water pressure in subsurface was found to be the major cause for development of a slope failure. Hence, horizontal gravity / lateral drains to reduce the prevailing pore water pressure in subsurface at the first berm level were constructed.

### Long term mitigation measures designed

1. Borehole investigation using rotary core drilling techniques and Standard Penetration Test (SPT) were continued. Rock core sampling for the observation of soil and rock types, was done to identify the soil and types, to gauge the thickness of overburden and to identify thickness of overburden, and to identify the slip surface of landslide.

2. Installation of piezometer to monitor the fluctuation of water table at the landslide area.
3. Laboratory testing of soil to determine soil parameters for the stability analysis and designing of mitigation measures.
4. Detail contour survey necessary in the analysis for designing mitigation measures.
5. Field permeability test to determine the degree of water seepage into different soil types in subsurface.
6. Ground Penetrating Radar (GPR) survey to determine the thickness of colluvium soil and depth of slip surface.
7. Resistivity survey to confirm the subsurface information observed by GPR survey.





## Official Training at Norwegian Geotechnical Institute (NGI), Oslo, Norway



Technical cooperation with Norwegian Geotechnical Institute (NGI), Oslo, Norway was started in 2012 to enhance the professional and technical capacities of NBRO in identifying and assessing the landslide hazards and ground subsidence incidents. The NGI initiated the donation of a latest high tech ground scanning device called Ground Penetration Radar (GPR) system to NBRO by the Norwegian Government to investigate the land subsidence hazard and provided necessary training too. Consequently, the NGI assisted NBRO staff to generate a new land subsidence hazard susceptibility map, using information collected during the GPR surveys conducted in Matale Municipal Council Area. In addition, Synthetic Aperture Radar (SAR) images were also used to calculate the ground variations in Matale region. Finally, NBRO developed a land subsidence risk map for the same area through a Socioeconomic and Environmental Vulnerability Assessment (SEVA). As per the technical collaboration, NBRO sent four officers to NGI for two-week training in January 2016. Views of the four officers are presented below.



*"NGI is pioneering institution that developed its own GPR. Concepts of GPR and its applications to interpret subsurface geological formation and variations were thoroughly explained, building up my confidence on how to identify an unknown subsurface geological structure/geological formation or any other anomaly using the GPR."*

*The geotechnical engineering laboratory of NGI is well known as one of the world's leading laboratories, and visiting that is a unique experience that gave me ideas and concepts on how to design such laboratory. We now have already incorporated these ideas into the design of the proposed laboratory building of NBRO. In future, we wish to adopt latest laboratory arrangements and procedure in the GED laboratory"*

... **KN Bandara**, Director/Geotechnical Engineering Division of NBRO



*"I was able to get hands-on training conducted by Dr. Kong and Mr. Pawel for several days, on the Ground Penetration Radar (GPR) technique which is one of the very useful geophysical techniques for subsurface exploration. Successful training on the above mentioned technique leads me for the completion of my main task of the visit. In addition it should be mentioned here that having the opportunity to attend to the training sessions of others fields was an extra benefit I got from this training and it expands my knowledge further. Visiting the laboratories of NGI was really interesting and it inspired me. Application of knowledge and experience gained from the training for the sake of future development of NBRO is one of my prime concerns "*

..... **Pathma Kumara Jayasingha**, Senior Scientist, Landslide Research and Risk Management Division



*"The NGI assisted Environmental Division of NBRO to investigate the contamination of groundwater by waste oils. The NGI provided training on site investigation, groundwater monitoring, and remediation of contaminated soil, groundwater and marine sediments conducted by Mr. Paul Cappelen, Head of Environmental Engineering."*

*At the NGI Environmental laboratory I learnt waste and leachate characterization tests and method for determining the extent of contaminant spread. NGI explained the use of biological organisms in the remediation of oil contaminated sites. It was very interesting and an advantage to visit and familiarize with the geotechnical and environmental laboratories; learning the layout plan, health and safety measures in the laboratory and the laboratory security. I learnt the principles of GPR technology and its use as nondestructive testing in environmental field, for the detection of oil contamination and salinity. By observing an oil contaminated site, I learnt the treatment on oil contaminated sites by pumping from wells and preventing the spread by forming dams at the site. NGI is engaged in research and applying the outcome in their constancy projects. They publish their research findings often and have very good cooperation with national and international organizations. And also I feel that the recognition of NBRO by NGI is incredible".* ..... **Madara Disanayake**, Senior Scientist, Environmental Studies and Services Division



*"I had a chance to discuss about present collaboration activities with the NGI and reporting activities. In addition, I learnt more about the landslide risk mapping methodology that we developed for Matale and landslide zonation mapping programme. I learnt about the drone based 3D mapping activities which were discussed and illustrated and gained skills on developing 3D mapping based on aerial images,. The 3D map which was developed for Rattota Landslide area was discussed in the presentation to calculate the contours, and identify the buildings. However, NGI explained very simple technology that can be used to develop precise contours. This technology would be helpful to us in future, to analysis the ground variations in high risk areas. Further, I was trained on GPR for assessing ground conditions. I was deeply impressed about the innovations and achievement by the NGI laboratory and that they build their own instruments and customize the equipment to their requirements. NBRO should focus on this subject in future."* ... **Dayan Munasinghe**, Scientist, Human Settlement Planning and Training Division

## Research and Development Programme

NBRO Research and Development (R & D) programme was rejuvenated in 2013 with the General Treasury restoring provision of their annual research grant to NBRO. This programme was continued successfully in the years of 2014 and 2015.

In the year of 2015, various studies were conducted under the broad theme of "Resilient Built Environment". This R & D programme was conducted with the objective of developing collaborative research culture within NBRO and thereby promoting NBRO's excellence in building research and development and strengthening the NBRO professionals through expert knowledge coming from effective research collaboration with external institutions. Dr. Prasanna Rathnaweera Senior Lecturer of the Department of Civil Engineering, Open University of Sri Lanka periodically evaluated the progress the research studies. The R & D programme was culminated by conducting the NBRO Annual Symposium at the end of the year. In this symposium, both the NBRO staff and external authors submitted papers and out of the 34 research papers received, 29 papers were selected from the submissions of NBRO staff. Some of the chosen papers were awarded with merit certificates.

NBRO received a research grant in 2016 to continue its Research and Development programme. Research proposals received from the NBRO scientists for the year 2016 comprise of many new proposals and also several proposals requiring the continuation of the research work of previous years. These proposals were presented to the Research Committee at the meeting held on 3rd March 2016. As per the advice of the Research Committee, initial literature surveys of these studies have commenced.

The new research studies are:

- Determination of the best mix for Bottom Ash Blocks and field conducting trials / testing on a model house
- Development of alternative roofing materials suitable for use in disaster resilient housing
- Development of alternative and sustainable materials for construction of gravity, semi-gravity and cantilever retaining walls



- Evaluating the hazard situation caused by the Karst subsurface conditions at Vijaya Srigama village, Digana, Kandy
- Determination of the effect anthropogenic pressure and the watershed resilience on stream water ecology and water quality
- Systematic diagnostic assessment of select chemical disasters in Sri Lanka
- Long term sustainability of post disaster housing reconstruction projects
- Flood risk assessment in Rathnapura Municipal Council Area
- Evaluation of presently applied designed criteria and mitigation measures for Sri Lankan landslides and selection of most suitable design by modeling
- Applicability of relative weights of existing landslide hazard zonation methodology for different terrain conditions of Sri Lanka
- Setting of standard rainfall for Early Warning System (EWS) considering past landslide incidences in Sri Lanka with reference to 24hrs working rainfall
- Contribution of geological structural orientation on cut slope failures along roads in mountainous terrain
- Finding the cause of land subsidence in limestone terrain of Achchuwlei area, Jaffna
- Performance study of concrete strengthening techniques in Sri Lankan context
- Behavior and pattern of description in relation with different rock types and its application for design of sub ground construction
- Modes of occurrence and geotechnical behavior of laterite in low land area
- Early warning system for landslides with threshold limits by using remote sensors: A case study of Badulusirigama landslide in Sri Lanka
- Settlement of shallow foundations on soils in Sri Lanka
- Use of soil nailing cost effectively in improvement of slope stability in Sri Lanka





# Reservoir Water Quality and Sedimentation Studies - Some Findings

By Sardhani Dias, Thushani Seneviratne



The Dam Safety and Water Resource Planning Project (DSWRPP) is focused on identification of the trends of water pollution and sedimentation of reservoirs of Sri Lanka due to a wide range of issues related to water quality deterioration and sediment accumulation. Realizing the importance and challenges in reservoir water quality management the Dam Safety and Water Resource Planning Project awarded the project “Reservoir Water Quality and Sedimentation Studies” to NBRO to assess the water pollution and sedimentation issues in selected hydropower and irrigation reservoirs of the country and to develop a framework to strengthen the water quality monitoring and reservoir water resource management capacities of the Mahaweli Authority (MASL) and the Irrigation Department of Sri Lanka.

## Sri Lankan Snakes; are we treating them right?

By Vimukthi Sumanasekara

Sri Lanka is rich in biodiversity and it is also considered as one of the global biodiversity hotspots. In its small land area Sri Lanka has relatively high biodiversity. There are large number of endemic fauna and flora in Sri Lanka. Intention of this article is to discuss briefly about one of the threatened species, the snakes of Sri Lanka, which comes under the group of reptiles.

When we hear a name of a snake, our mind tends to get confused, and get scared because we think that all snakes are poisonous, repulsive, etc. But this is not always true. If you study a little more deep about snakes you will come to know that reality is a far cry from the misconceptions rooted in our minds as snakes are one of the most innocent creatures living in terrestrial habitats. And even historical evidences hint that snakes had a niche of their own in the society and culture. They were carved in guard stones, thovils, traditional masks, etc.

Another misconception is that all the snakes are deadly poisonous. There are 110 species of snakes in Sri Lanka. These snakes are categorized in to 4 groups according to their poisons.

These are,

- 1) Deadly venomous,
- 2) Moderately venomous
- 3) Mildly venomous,
- 4) Non venomous

According to the above classification, only the deadly venomous snakes can kill humans and there only 5 species out of 110 species which can be considered as deadly venomous. These are,

- 1) Common Krait (*Bungarus caeruleus*) කෙලේ කරවලා
- 2) Sri Lankan Krait (*Bungarus ceylonicus*) මුදු කරවලා
- 3) Cobra (*Naja naja*) නාගයා
- 4) Russell’s Viper (*Daboia russelii*) තින් පාපළහා
- 5) Sri Lanka saw scaled Viper (*Echis carinatus* Sinhaleus) වැලි පාපළහා

Seven Key Project Tasks Performed By NBRO

1. Analysis and interpretation of MASL existing water quality raw databases of Polgolla, Kalawewa and Kothmale reservoirs to express the trends of water quality deterioration over the past years
2. Establishing modern water quality monitoring laboratory facilities at (MASL) Digana and Thambuththegama and associated staff capacity development and the establishment of bathymetry units in MASL Digana and Irrigation Department (ID), Colombo
3. Reservoir sedimentation study - Modelling of sediment yield from the catchment (HEC-HMS model), sediment flow and routing through the river network up to the reservoir (HEC-RAS model), and sediment flow pattern and deposition in the reservoir (SMS\_SRH-2D model)
4. Simulation of reservoir and catchment water quality using DYRESM-CAEDYM model and MIKE HYDRO BASIN model
5. Water quality, sediment quality & limnology characteristics assessment in Polgolla, Kalawewa and Kothmale reservoirs and stream water quality assessment of Polgolla, Kalawewa and Kothmale reservoirs
6. Bathymetry surveys and assessment of storage depletion and updating the area capacity curves of Polgolla, Rantambe, Kalawewa and Inginiyitiya reservoirs
7. Propose a comprehensive catchment management plan considering watershed pollution, sediment management and policy development for Polgolla Reservoir

However, in certain classifications, Hump – nosed Pit Viper කෙලේපයා (*Hypnale hypnale*) and Sri Lankan Green Pit Viper පළා පාපළහා (*Trimeresurus trigonocephalus*) are also classified under the deadly venomous group. Anyhow out of 110, only 7 species are deadly venomous and there are no records of deaths caused by any of the other 103 species found in Sri Lanka.

However, we tend to kill any snake which crosses our path without any remorse. Snakes already have natural enemies of their own such as eagles, land monitors, civets, jungle cats, wild boar and mongoose who hunt snakes. Snakes cannot run or fly since they do not possess feet or feathers; they can only crawl. Therefore snakes are highly threatened species who are vulnerable in surviving. Nevertheless, their role in ecological balance is significant. Hence, responsibility of conserving these creatures are vested upon us.



# Sentinel Asia Mini Project 2015-16 Sri Lanka

Sentinel Asia aims to promote international cooperation to monitor natural disasters in the Asia-Pacific region. It uses earth observation satellites and other space technologies to collect disaster-related information. The aim is to mitigate and prevent damage caused by natural disasters such as typhoons, floods, landslides, earthquakes, tsunamis, volcano eruptions and wildfires. The "Sentinel Asia Mini Project" is an end-to-end capacity building project undertaken by Geoinformatics Center-Asian Institute of Technology, Thailand (GIC-AIT) with support from JAXA. Accordingly, JAXA and GIC-AIT decided to conduct a Mini-Project for year 2015-16 in Sri Lanka to improve the effectiveness of its Sentinel Asia (SA) initiative, especially on landslide risk management. Under this, organizers planned to integrate ALOS-2 and other satellite images with an open-source model to assess the selected study areas. The Mini-Project was conducted under three phases.

With the participation of JAXA, GIC-AIT, National Building Research Organisation (NBRO) and Survey Department of Sri Lanka (SD) jointly conducted a kick-off workshop of the Mini-Project (Phase I) on ‘Utilization of Remote Sensing and GIS for landslide risk management’ on 21st September 2015 at Survey Department, Sri Lanka. The program was sponsored by the Japan Aerospace Exploration Agency (JAXA). Following the workshop, a discussion was conducted to finalize methodology and the study area and to collect data from local organizations for the analysis. There were about 30 participants attended the workshop from different agencies related to disaster management in Sri Lanka. The second phase of Sentinel Asia Mini-Project 2015-16 was held at Geoinformatics Center (GIC) of Asian Institute of Technology (AIT) from 16th November 2015 to 11th December 2015. Two participants from each country, Sri Lanka, Bhutan, Indonesia, Nepal, and Vietnam attended this workshop. Ms. Hasali Hemasinghe, Scientist from NBRO and Ms. Shiromi Rangali, Government Surveyor from SD participated in the phase II as representatives from Sri Lanka. During this four week workshop, the participants were trained on many remote sensing and GIS software.

Simultaneously practices of Data Processing and Modeling were performed to achieve the final outputs of the study.

In this mini project mainly three analyses were performed as, Landslide susceptibility mapping by using logistic regression (LR) model, Identification of landslide by using Synthetic Aperture Radar (SAR) and Identification of ground displacement by using Synthetic Aperture Radar Interferometry (InSAR).

By means of LR analysis, the tendency to landslide occurrences was assessed by relating a landslide inventory (dependent variable) to a series of causal factors (independent variables) which were managed in GIS environment. Rain fall, lithology, slope, aspect, distance to road, distance to rivers were selected as the causal factors. The results of landslide susceptibility analysis showed that most of the observed landslides points were located in high and very high susceptibility categories. The model seems to be reliable in Badulla District. The SAR image analysis was applied to identify Meeriyabedda landslide location and InSAR image analysis was applied to identify a slow moving landslide located at Badulusirigama model village premises in Badulla district. Identification of the landslide using SAR image was not successful in this study and resulted Interferograms phase in the InSAR analysis was not good enough to get clear idea about the deformations.

The final phase (Phase III) of Sentinel Asia Mini-Project 2015-16 was held at Survey Department of Sri Lanka from 15th to 18th February 2016 to disseminate the results of Mini-Project. Final presentation was conducted by participants to disseminate the outputs of the project and discussion was held to identify the way forwarding of mini project results and the new prospective towards sentinel Asia activities were introduced and the ongoing problems were also addressed. The workshop was held in the Conference Room of SD, Sri Lanka. 30 participants from different agencies joined the workshop. Overall Mini-Project was successful with the hope of minimizing disaster impacts in the future.

