7.1.7 HARDNESS AND PRESENCE OF ARSENIC IN AQUIFERS OF SELECTED CKDU PREVALENT AND OTHER AREAS IN SRI LANKA

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Introduction: Presence of arsenic in drinking water is a serious public concern as it is a class I poison that affects human health. A frequent complaint of the inhabitants of chronic kidney disease of unknown aetiology (CKDu) endemic areas, who primarily are farmers, is the increasing hardness in dug wells and tube wells that receive water from aquifers.
Objective: To determine and compare the total hardness and arsenic content in aquifers in selected CKDu prevalent and non prevalent areas in Sri Lanka
Study design, setting and methods: Groundwater samples were collected from dug wells in Padavi-Sri Pura (n=36) and Polpithigama (n=17) areas where chronic kidney disease of unknown aetiology (CKDu) is prevalent as well as from Moneragala (n=38) and from Thanamalwila (n=19) where no CKDu patients present, nevertheless a significant number of patients with calculus kidney disease have been reported. Besides, groundwater from Matale (n=11), and Pasgoda-Deniyaya (n=10), where no CKDu incidences have been reported too were collected and all water samples were analyzed for total hardness and for arsenic by using the atomic absorption spectrometer with graphite furnace detector.
Results: Average hardness in Padavi-Sripura (270+54 – 820+62 mg L^{-1}) and Polpithigama (90+8 – 615+47 mg L^{-1}) was greater than that of Moneragala (10+2 – 340+31 mg L^{-1}), Thanamalwila (170+8 - 500+24 mg L^{-1}) and Matale (60+5 – 460+21 mg L^{-1}). Hardness of Pasgoda water was < 60+6 mg L^{-1} and no arsenic was detected in it. The average contents of arsenic in groundwater varied among areas, i.e. Padaviya (21.07+3.54 - > 100.91+12.31 µg L^{-1}), Polipithigama (2.49+0.61 – 60.55+7.21 µg L^{-1}), Moneragala (2.14+0.84 – 52.47+6.71 µg L^{-1}), Matale (1.02+0.08 -37.1+4.4 µg L^{-1}) and Thanamalwila (39.37+5.21- >100.42+9.45 µg L^{-1}).
Conclusion: A strong positive ($p<0.05$) correlation was revealed between the arsenic content and groundwater hardness in CKDu prevalent areas when compared to the other areas that showed a weak correlation between the two variables. The present study also indicated that arsenic associated with elevated levels of hardness can reasonably be one of the potential causes of CKDu.

7.1.8 PRELIMINARY INVESTIGATIONS ON PRESENCE OR ARSENIC IN SOILS AND PLANTS FROM TWO CKDU PREVALENT AREAS IN SRI LANKA

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Introduction: In recent years a significant increase in patients of Chronic Kidney Disease of unknown aetiology (CKDu) has been observed in some parts of Sri Lanka, especially in North central province. Arsenic is well recognized as an element of public concern due to its high toxicity and carcinogenic properties. The present study was carried out in relation to the hypothesis that presence of arsenic in the groundwater aquifers in CKDu prevalent areas is the potential cause of the disease.
Objective: To determining arsenic content in soil profiles and selected aquatic and terrestrial plants in Padaviya and Polpithigama/ Nikawewa areas with a view to understanding the vertical and horizontal (spatial) distribution of arsenic in the environment.
Study design, setting and methods: Soil samples were taken in triplicate at 1 foot depths down to 12 feet from paddy fields, homesteads and draw-down areas of Padaviya reservoir using a spiral auger. Samples of plant parts from common plants in the study areas were tested for presence of arsenic using the atomic absorption spectrometer after acid digestion.
Results: All surface soil samples contained total arsenic contents greater than those in the bottom horizons of the soil profiles. Surface layers of soil in paddy fields of Padaviya area were detected to have relatively high levels of arsenic (1.5 mg kg^{-1}) when compared to that of the deep layers (0.61 mg kg^{-1}). No arsenic was detected below 7 feet depth in Padaviya reservoir. Bark of *Azadirachta indica* (Kohomba) (> 100 µg L^{-1}) was found to accumulate the greatest amount of total As while it was observed that roots and

leaves of *Terminalia arjuna* (115±2.4 µg L^{-1} in bark, > 100 µg L^{-1} in roots) too accumulate As more than the other tree species. *Eichhornia crassipes* (553.5± 2.4 µg L^{-1}), the aquatic floating plant and flowers of *Nelumbo sp.*(rooted aquatic plant) (1101± 10.2 µg L^{-1}) were found to contain excessive amounts of arsenic.

Conclusion: The results of the present study revealed that presence of arsenic in the soils and plants, particularly in the agricultural areas gradually decreases with depth, indicating that it is not present naturally in the bedrocks nevertheless has been introduced from the surface, most probably due to anthropogenic activities such as agrochemicals.

7.1.9 ARSENIC , CADMIUM OR PEOPLE ?

By Dilrukshi Handunnetti

Quite the unusual week it was with two different agencies presenting somewhat different research findings on the status of one of Sri Lanka's slow emergencies: the chronic kidney disease referred to as CKDu, short for chronic kidney disease of unknown aetiology.

Sri Lanka was treated last week to a kidney 'disease-related spectacle' with the Ministries of Health and Water Supply and Drainage releasing two different survey reports in two different locations - Colombo and Anuradhapura - on two consecutive days - with different partner organizations.

While one group clearly identified arsenic to be the cause and made strong recommendations towards a strong regulatory framework to quality control agrochemicals and fertilizer, the other called for the provision of better medical facilities and clean drinking water to villagers to reduce dependence on poor quality groundwater.

The World Health Organization

According to World Health Organization (WHO) statistics, 10 countries are affected by the killer disease including Sri Lanka. Given the high prevalence of kidney disease in Sri Lanka, specially in the country's North Central Province (NCP), the WHO appointed an international team to conduct research, at the invitation of the Ministry of Health. The research commenced in 2010 headed by Prof. Shanthi Mendis, the former professor in medicine and a Geneva-based senior consultant with the WHO at present.

Prof. Paranagama, a researcher associated with the WHO initiative said the research was undertaken in the North Central, North Western, Uva and Eastern Provinces to seek answers to four key research questions. They were: What is the level of prevalence? What is the incidence level? Exact geographical distribution of CKDu? What strategies could prevent the condition?

Three of the papers released prepared under the name of Prof. Mendis, the WHO-Health Ministry combined emphasized on the arsenic factor - but ruled out water.

According to their research findings, some 400,000 kidney patients in the North Central and Uva Provinces were within the age bracket of 15-70 years. In the past 20 years, some 22,000 people have also died due to CKDu, the researchers claimed confirming that approximately 215% of the Sri Lankan population suffered from kidney disease in some form or the other.

They also identified a highly susceptible group, men over 40 years of age, who are engaged in farming for over a decade. This was to indicate that working with agrochemicals for long years was directly connected to the disease.

Arsenic's direct link to the disease

The WHO team identified arsenic's direct link to the disease that is fast spreading in Sri Lanka- and warned that the numbers would increase in the coming years with North Western, Southern and Eastern Provinces also showing signs of affliction.

This team also made an alarming statement that unless and until urgent measures were taken by the health authorities, and soon there could be a situation of nobody being left in the NCP. "It is that bad," insists Paranagama.

Effect of agrochemicals

The WHO had stressed the need to regulate imported fertilizer, particularly with nephrotoxic agents such as cadmium and arsenic and reduce the exposure of farmers to the harmful effects of agrochemicals by educating them on their dangers, controlling the sale of agrochemicals, known to be nephrotoxic and by adopting a strategy to address the absence of quality control and regulations related to toxic impurities in fertilizer.

Meanwhile, another stakeholder group, the Ministry of Water Supply and Drainage, was also associated with the releasing of survey findings on the same issue by a New Delhi-based research and advocacy organization, Centre for Science and Environment (CSE).

The CSE research too is in agreement with the WHO study to the extent that heavy metals in water are ruled out as the cause and the spreading of the disease to the adjoining provinces.

"This research yielded that not just the NCP but Uva, Eastern, North Western, Central and Northern Provinces are also getting affected by the killer disease. The affected area covers approximately 17,000 sq km and is home to about 2.5 million of the Sri Lankan population. More than 95% of these people are rural dwellers," notes Deputy Director General, Centre for Science and Environment, Chandra Bhutan.

"The CSE study rules out heavy metals in the water, the touted cause for the disease, though water quality in the area surveyed did prove to be of poor quality with high levels of hardness and calcium and fluoride content," he adds.

According to the CSE, samples of soil, food commodities (rice grain and plant), pesticides and fertilizers were also tested for arsenic to study their linkage with CKDu.

The CSE findings claimed that cadmium, arsenic, chromium and lead were not detected in the drinking water samples collected either from the affected area or from the unaffected area. The results also held that arsenic was not detected in rice grain and rice plant samples collected from the affected region either.

Adds Bhushan, "The study shows that heavy metals, cadmium, chromium, arsenic and lead, in drinking water are not linked to CKDu in the NCP. We do not rule out heavy metals. If heavy metals are responsible, then there is a different source for them than the drinking water and that source should be explored."

Poor quality water

The research, according to General Manager, National Water Supply and Drainage Board (NWSDB), Lal Premanath, should be an eye opener. "There was no arsenic detection in the rice and grain samples collected from the area considered affected. But the WHO report makes strong inferences to food being the cause. More answers are needed. From this effort, we understand that the water quality is extremely poor. The need is for better drinking water at the village level," he said.

With so much politics clearly presenting different causes for kidney disease in Sri Lanka. The Ceylon Medical Journal's Volume 56, No. 4 issued in December 2011, contained the writing of three reputed medical researchers, K. P. Wanigasuriya, A. R. Wickremesinghe and R. J. Peiris-John, where it was stated that establishing causality was difficult and even suggested Sir Bradford Hill's minimum conditions to be followed to establish causality, the very basis of modern epidemiologic research.

It added: "The 'battle' over establishing the cause of chronic kidney disease of unknown aetiology (CKDu) in the NCO, the seat of Sri Lanka's ancient civilization, has been highlighted in many newspapers, television and radio programmes in recent years." It emphasized on the need for 'fair and accurate reporting on science based on the weight of evidence'

It also said, "As we approach the end of 2011, there is still little scientific evidence of the determinants of kidney disease or its aetiology".

The call, therefore, is not to engage in this battle - to suppress facts or dramatize the causes but for the health policy makers, experts and implementers to come up with an action plan that can control the killer disease. If the 400,000 statistic is trusted, then Sri Lanka has a real problem and one that is fast spreading. There is no time to be lost with CKDu.

Sri Lanka being readied - Health Ministry official

A top Health Ministry official told Ceylon Today that a special treatment centre for kidney disease has been established by the Ministry of Health with a special kidney treatment centre in the Polonnaruwa District. "Special units for kidney patients will be set up soon at every main hospital in the NCP where the prevalence of the disease is high," he said.

Urgent fixes - Vithanage

Executive Director, Centre for Environmental Justice, Hemantha Vithanage, said that both surveys remained inconclusive about a variety of issues and stressed on the need to have long-term and short-term approaches.

"Both studies have ruled out water as the cause. In the interim, it is important to ensure sufficient health support, dialysis facilities, improved drinking water supply and health awareness."

Spreading of kidney disease in the NCP is heavily impacting on community health. There is youth migration and lack of medical care for the older generation. It is a health problem with serious socio-economic impact and should be a political priority to address this."

Arsenic is the cause - Prof. Paranagama

Head of the Chemistry Department of Kelaniya University, Prof. Priyani Paranagama, told Ceylon Today that the WHO research team had found traces of arsenic on the hyper pigmentation of the soles and palms of patients. Some autopsies of those who died of CKDu have established the retention of arsenic in hair and nails.

Paranagama said the research findings had to be disclosed to the public to urge authorities to take immediate action. "The research team calls for the regulation of imported fertilizer, particularly those with nephro-toxic agents such as cadmium and arsenic. Practical steps are required to reduce the exposure of farmers to the harmful effects of agrochemicals through awareness creation coupled with a stringent quality control strategy that will prevent substandard chemicals reaching the shores."

At the next phase of the research, attention will be paid on how to clear the soil of arsenic residue.

It is about our lives – patient

Manatungage Davith Hettiarachchi perhaps epitomizes the real problem in the kidney disease-affected North Central Sri Lanka.

With some 155 of the population suffering from kidney disease and at least 5% from renal failure; NCP's health concerns are a human tragedy.

This 67-year-old kidney patient, a former school teacher who is currently undergoing treatment at the Padaviya Sripura Hospital, in a telephone interview lamented the absence of some quick solutions to the emergency health concern.

Faulting the scientific community for dabbling in scholarly debate on determinants, he said the issue was the dire medical needs of an affected population.

"In our villages, people don't wish to marry persons who have a family history of kidney disease.

Most people have weak physique and cannot work on their fields. The youth migration to cities is high. They migrate in search of better quality water, not jobs. The older generation is suffering without adequate health care," he said.