CKDu: Scientific evidence and anti-science zealotry - I

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by Dr U P de S Waidyanatha

'Do not reach judgment on the identity of the elephant merely on the basis of the size of its footprints or the tusk marks it has made on tree trunks or the height of branches it has broken'.

Chulla Hatthi Padopoma Sutta - Arahath Mahinda's sermon to King Devanampiyatissa

Many investigations have been done by various scientists and the WHO over the last several years, reports and research papers published but the aetiology of the chronic kidney disease (CKDU) afflicting over 15% of people of the North Central Region (Rajarata) yet remains speculative. As in the sutta cited above, there are bits and pieces of evidence but probably inadequate to reach definite conclusions as to the cause of the disease, which may well be multi-factorial. However, the hypotheses propounded by some but refuted by others are:

1. Fluoride in the water and its reaction with aluminum in poor quality cooking utensils

2. Heavy metals, particularly, arsenic (As)and cadmium (Cd) in the water and/or food chain

3. Hardness of water

4. Algal and herbal toxins

5. Agrochemicals – fertilizer and pesticides

Fluoride

The hypothesis (Ileperuma, 0 A and others, 2009) that high fluoride contents in the drinking water and aluminum fluoride complexes produced as a result of cooking in poor quality aluminum pots, it has been argued by other researchers, fails to explain the geographical distribution of CKDU as fluoride levels in the drinking water were equally high in CKDU non endemic areas as in endemic areas, and similar aluminum pots are used in both areas. However, the differences in the environment and life styles of the communities in the affected geographic areas visa vis those of the unaffected communities should also be taken into the overall equation.

Cadmium

The claim of high cadmium (Cd) levels in water and food sources such as rice, lotus rhizome and fish as a causal factor (Bandara, J M S and others, 2007) was refuted in a subsequent publication which reported higher Cd levels in water in the disease non –endemic areas than in the endemic areas (Chandrajith, R and others, 2010), and much lower levels in the rice than reported by Bandara and others. More on Cd is discussed below under the WHO Report.

Arsenic

A team of researchers of the Rajarata and Kelaniya Universities and others (R&K Team for short) in several publications express the strong view that arsenic (As) is the main cause of CKDU. Deposits of crystals of calcium arsenate in the post-mortem tests of diseased kidneys, as a result of As reacting with the hard water common in the region, much higher As levels in the drinking water (0.02 to 0.1 ppm) than the WHO safe limit (0.01 ppm) , high levels of As in rice grown in the area and in the hair of diseased subjects have been reported. The rice plant is known to accumulate up to 10 fold more As compared to other major crops, and according to some research reported, the As levels in the local rice had alarmingly increased over the years from 34 - 94 parts per billion (pbm) in 2004 to 90-260 in 2010. There is concern the world over about high As in rice, and the US consumers are pressuring the Food and Drug Administration to set guidance on allowable levels or As in rice. It has also been reported that the contents of lead (Pb) are much higher in rice imported from some Asian countries than in rice produced in the US. This may mean that the large rice eaters like much of the local population that eats three meals of rice a day are at greater risk of heavy metal poisoning than those who eat less.

Dr Jayasumana of the Rajarata University Medical Faculty, a leading proponent of the As hypothesis, has argued that the bed rock and minerals of the Rajarata have no As and that their research reveals that agrochemicals are the source of As in the soil and water. However, other geological researchers have established the presence of As in the bed rocks and soils of the region, and yet others have reported no difference in the As and Cd levels in agricultural soils visa vis other soils. There is hardly a soil anywhere in the world without at least traces of As. In the USA, for example, there are reports of 7.2 ppm arsenic in agricultural soils and the

European Community's (EC) maximum limit of As for agricultural soils is 20 ppm. The Centre for Science and Environment , Delhi (CSE) investigation on CKDU made in 2012 reveals As levels of 0.06 ppm and 0.035 ppm in the soils of affected and unaffected (Kandy) regions respectively. These levels are well within the said EC limits.

In an article entitled "CKDU and As poisoning due to illegal pesticides", the R&K Team implicates agrochemicals as the source of As, present either as impurities/contaminants or purposely added to enhance the potency of the pesticide! The Jayanthipura correspondent of The Island newspaper in its issue of 27th of March 2013 reports Dr Jayasumana as having said that the 'level of As in agrochemicals available in the Anuradhapura and Polonnaruwa Districts was much higher than that in the other parts of the country' . Are the agrochemical companies specifically targeting to poison the Rajarata farmers? What a preposterous comment if at all it was made! This contention that As is purposely added to enhance the activity of the pesticide is refuted by the Registrar of Pesticides, the regulatory authority for pesticides, who points out that As is present in some pesticides and fertilizer as impurities but within limits allowed by regulatory organizations internationally.

The CSE investigation failed to detect heavy metals inclusive of Cd and As in the drinking water from the affected area (35 samples) and unaffected control) area(5 samples) or in rice. They had however analyzed only a few samples of rice grain (2) and plants (4). The WHO (Mission Report –June 2011) reported 3 out of 118 potable water samples from the Rajarata that were analyzed to have 'slightly higher' (meaning marginally above WHO safe limits) levels of As but the Final Report (see later) clears potable water of As contamination above safe levels. This a good example of analytical errors that could lead to wrong conclusions, a matter discussed later

Jim Bridges, Professor of Toxicology and Chair of the EU Scientific Committee on Emerging and Newly Identified Health Risks in his presentation at a recent symposium on CKDUE held in Colombo pointed out that the kidney is not a primary target of As toxicity in any of the countries with endemic high levels of As, and the classic symptoms of As toxicity (skin)do not appear to be common in the affected areas here. On the other hand, in the article referred to above, the R & K Team presents evidence of skin damage – hyper pigmentation and keratosis of palms and soles in addition to kidney damage The widely reported Bangladesh subjects of As poisoning from drinking water from deep wells are reported to be afflicted by cancer of the lung , skin and bladder and cardio-vascular disease and not kidney damage. Arsenic is usually categorized, worldwide, as a class one, non-threshold carcinogen.

Dr Mannapperuma, a specialist in water treatment, in an article that appeared in the Sunday Times of 7th April 2013 argues the possibility of arsenite in paddy fields being absorbed through the skin of farmers working long hours in paddy fields, usually bare footed. He points out that low oxygen (anoxic) conditions in paddy soils can lead to the reduction of arsenate(pentavalent form) to arsenite (trivalent form), the uptake of which through the skin is reported to be 29 times higher than arsenate This may explain the skin conditions reported by the R & K Team. However, paddy farming is as old as our civilization, and CKDU is a

recent phenomenon. Thus why such As toxicity symptoms were not detected earlier remains to be explained unless it is to be totally attributed to agrochemicals a consequence of the Green Revolution. On the whole the available evidence to categorically implicate As as a causal factor in CKDU is inadequate, and more comprehensive investigations on As in soil, water, food and humans living in the CKDU endemic and non-endemic areas are needed for reaching conclusions, and this is urgent

Interestingly, at the other end of the spectrum, evidence of As essentiality (of course in trace quantities) has been reported in studies done with animals as well as humans. It is believed to have a physiological role in the metabolism of an essential amino acid, methionine.

Hard water

There is consensus that hardness of the drinking water could be a causative factor. The total hardness of drinking water of CKDU patients has been reported to be very high and that their distribution pattern coincided with the geographic distribution pattern of high ground water hardness. Further, a positive correlation has been claimed between As content and the water hardness by the R & K Group. However, Dr 0 A Ileperuma , Professor of Chemistry, University of Peradeniya, also the proponent of the fluoride theory points out that the hard water should precipitate As as calcium arsenate and hence the risk of As getting into subjects from the water should be minimal. He also questions why CKDU is not prevalent in other hard water areas such as Dambulla and Hambantota which are also farming areas with intensive agrochemical use

Algal toxins

Algal (Cynobacterial) toxins as a possible cause has been proposed (Dissanayake,2011). It is argued that the high CKDU prevalent areas are clustered around reservoirs and analysis of water therefrom revealed blooms of Cynobacteria capable of producing heaptoxic and carcinogenic effects whereas low-prevalence of the disease was observed in communities that used potable water from natural springs, and water from the springs contained no algae or cynobacteria and very low levels of fluoride, phosphate, nitrogen and potassium.. In an article on the algal bloom that occurred in the Ulhitiya reservoir last January in The Island of 20th of this month, Professor S A Kulasooriya, an algologist also discusses the seriousness of algal toxins. Amongst other things he states that these toxins are not destroyed by boiling the water and can accumulate in the body even passing from lactating mothers to the infants.

Herbal toxins

Herbal (Ayurvedic) medicines have been purported as one of the possible causes of the disease as people in the region rely heavily on such medicines. Aristolochia (Sapsanda/Sassanda), one of the common herbs growing in the region and used in herbal

medical preparations which contain the toxin aristolochic acid, a compound implicated in a similar kidney disease as CKDU called Balkan Endemic Nephropathy (BEN) that has been prevalent in the Balkan region for over 60 years. Elsewhere (India for example)) too, there are reports of nephrotoxic effects associated with some herbal medicines. It is reported that some 66 Ayurvedic prescriptions contain Sapsanda. However, apparently many are externally applied and only 10% of the local Ayurvedic doctors use Sapsanda.

Is phosphate fertilizer an unseen villain?

In a highly informative article in The Island of 22 nd of last month entitled Excess phosphate fertilizer, key cause of algal blooms' a former Director General of Agriculture, Dr Sarath Amarasiri and his colleague Mr,Upali Yapa both soil scientists, make the alarming revelation that up country potato farmers apply over ten times the Department of Agriculture recommended dosage of triple superphosphate which is reported to contain Cd and/or As as impurities. Whereas a soil P content of 3Oppm is adequate for the potato crop and any excess P application is unlikely to raise crop yields, and therefore not only wasteful but harmful too, soil analysis had revealed that about 70% of Nuwera Eliya and 83% of Badulla farms exceeded this value. Some countries have established an environmental critical P value of 60 ppm which should not be exceeded. Nearly half the Nuwera Eliya farms had P values exceeding this critical value and some had P values in excess of 300 ppm! Some countries have taken legal measures to control soil P build up, and the authors say that such high values have hardly been reported from other countries.

Soil erosion and run off carry phosphate into the reservoirs below leading to eutrophication (nutrient enrichment) , algal blooms being a result. Phosphate is critically important for rapid growth of algal blooms. The most recent one was at Ulhitiya and Rathkincla reservoirs in last January. These and many of the other reservoirs in the Rajarata are reported to be highly nutrient po I I uted (hype rtrophic) and the consequences will be very grave if the government fails to act promptly and decisively. Clearly the heavy fertilizer subsidy without regulatory control of their use is contributing to profligate use of fertilizer leading to enormous economic losses and environmental pollution.. Is the fertilizer profligacy of the upcountry farmers the bane and burden of the Rajarata farmers? Algal toxins, Cd and As are implicated in CKDU and is phosphate fertilizer behind a triple assault? The high-powered Interministrial Committee has recommended to the Parliamentary Advisory Committee on CKDU to reduce triple superphosphate imports. What is really necessary is to strictly regulate its application through a mechanism that will allow phosphate fertilizer use strictly on the basis of a soil analysis report.

(To be concluded tomorrow)