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EDITORIAL

Paddy farming, fertilizer, and chronic kidney disease with an undetermined origin

Chronic kidney disease of undetermined (CKDu) origin is devastating agricultural communities not only in Sri Lanka but also in many other countries in the tropical equatorial belt (Chandrajith *et al*., 2011). The disease is reported to affect the farming workers such as paddy farmers in Asia and sugarcane workers in Latin America who work in hot and humid climates. In some areas in the dry zone of Sri Lanka, over 10% of adult farming communities are affected by this new form of kidney disease (Vlahos *et al*., 2019). After identifying this new entity of kidney disease in the mid-1990s, a large number of research studies have been published describing clinical, pathological, geo-environmental, and socio-economic aspects of the disease. These studies proposed over 65 possible etiological factors but still, risk factors are remaining inconclusive. Dehydration and environmental exposure to toxic trace elements such as, Cd, and Pb have been considered as possible etiological factors for the emergence of CKDu that is widespread in certain pockets in the dry zone areas of Sri Lanka. Based on the histopathological studies, the epidemic of CKDu is considered as a phenotypic environmentally induced disease that may contribute from environmental, occupational, and social factors. Since the majority of these patients are involved in rice farming activities, few studies argued that the application of agrochemicals could be the course behind CKDu, although it is much debated. Since contaminated rice can be a vehicle of toxic elements, rice grains, rice-growing soils, and fertilizers were investigated in detail during the last few years.

Modern agriculture in Sri Lanka mainly depends on the use of fertilizers and pesticides that can affect the soil quality detrimentally and severe deterioration in the soil quality may lead to permanent degradation of land productivity. Rice farmers in the dry zone of Sri Lanka are believed to use an excessive amount of agrochemicals and their wrong blends. Nitrogen and phosphates can affect adversely the soil-water system in areas where paddy farming is widespread. In Sri Lanka, chemical and mineral-based fertilizers are widely used in rice cultivations. Urea, ammonium sulfate, Triple Superphosphate (TSP), and Muriate of Potash (MOP) are regularly used in paddy farming. Of these fertilizers, TSP contains major plant nutrient phosphorus (P) but also consists of many other trace elements of which some are toxic (Dissanayake and Chandrajith 2009). In general, apatite mineral structure may include heavy metals such as As, Cd, Cr, Hg, Pb, Se, U, and V. In addition, some heavy metals can be introduced as impurities from sulfuric and phosphoric acid that are used in manufacturing processes of TSP. Therefore, the long-term application of agrochemicals may result in the accumulation of trace metals in agricultural fields.

Our recent investigations indicated that content of trace elements in mineral-based fertilizers such as TSP are higher than chemical fertilizers. In general, trace metals such as Zn, Ni, Cu, Fe, Ti, Sr, and Mn are available in elevated concentrations in TSP. For instance, impurities in TSP fertilizers in Sri Lanka were found to contain up to 46.1 mg/kg of Cd (Balasooriya *et al*., 2021). The problem is compounded by the fact that very low-quality fertilizers are imported into Sri Lanka due to the absence of proper control mechanisms. Although fertilizers are used excessively in paddy farming, an island-wide survey carried out recently indicated that rice paddy soils are not exceptionally contaminated with heavy metals (Balasooriya *et al*., 2021; Rubasinghe *et al*., 2021). In this study, 102 soils samples collected from main climatic zones viz. wet and dry zones, including CKDu hotspots were analysed for their trace element contents. Although As, Cd, and Pb, contents are moderately enriched in both climatic zones with respect to their background levels, the geo-accumulation index assorted that the paddy soils were uncontaminated to moderately contaminated, implying that rice paddy soils are not alarmingly contaminated with toxic trace elements. Interestingly, higher P levels were noted in paddy soils from CKDu hotspots in the dry zone. Long-term application of TSP, organic fertilizer, and animal manure leads to the accumulation of P in rice paddy soils. Similarly, 17 to 298 mg/kg of P with a mean of 156 mg/kg were also found in the highly agricultural regions of Nuwara Eliya (Amarawansha and Indraratne 2010), indicating that the availability of extractable P in both rice and vegetable soils. In general, the need for Olsen extractable P for optimum crop production is less than 30 mg/kg while it has been proved that some plants perform well under higher (48 mg/kg) P in soil (Kirthisinghe *et al*., 2007). Nearly 60% of paddy soil and 46% of garden soils in the CKDu hotspot of Wilgamuwa showed higher extractable P content than 48 mg/kg cut-off (Balasooriya *et al*., 2021).

To provide sufficient nutrients to the soils which regularly used for cultivation required to add fertilizers otherwise the crop yield becomes drastically depleted. Without a excessive yield, requirement of foods to feed millions of mouths cannot be fulfilled. It is well-known that most Sri Lankan farmers use higher than recommended amounts of fertilizer, intending to improve economic benefits. Therefore, controlling the use of fertilizers for crops needs to be thoroughly monitored by the responsible authorities. Most importantly, regular and continuous monitoring of fertilizers imported to the country is important, particularly for mineral-based fertilizers. In addition, soils in rice paddy and other agricultural fields need to be monitored regularly, and tthereby the required

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nutrient levels can be recommended. However, hundreds of studies carried out by various national and international researchers so far confirmed that the impact of toxic elements in rice or rice paddy soils on incidences of CKDu in the dry zone of Sri Lanka is negligible, as most of the trace elements levels in rice or rice growing soils are within acceptable levels.

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