Anthropological reflections on water consumption patterns around CKDu in Ginnoruwa

Upul Kumara Wickramasinghe
Department of Anthropology, University of Durham, UK.
upulkw@gmail.com

Abstract

Chronic Kidney Disease of uncertain etiology (CKDu) has become a major public health burden in Sri Lanka over the last three decades. Out of many proposed causative factors, polluted water has been attracted by far the most as the main source of CKDu causation, hence providing safe drinking water has dominated disease prevention interventions carried out by state and non-state actors. In light of the concept of "Appropriate Technology", in this paper, I review RO-filtration and rainwater harvesting – two major alternative drinking water supply methods in use to address CKDu epidemic. Based on my ethnographic study in Ginnoruwa, a CKDu-affected village in the dry zone, I suggest that rainwater harvesting could be more appropriate as a drinking water supplying method compared to RO-filtration, under the condition of proper maintenance and a financial support system.

Key words: *CKDu, Appropriate Technology, RO-filtration, rainwater harvesting*

Introduction

Chronic Kidney Disease of uncertain etiology (CKDu), arguably one of the most serious public health issues in Sri Lanka, has disproportionately affected rural, poor, male farming communities mainly in the dry zone of Sri Lanka (de Silva et al., 2017). CKDu was first identified in the early 1990s, as a form of kidney failure not linked with known causes of chronic kidney disease such as Type 2 diabetes mellitus, hypertension, and obesity (Athuraliya et al., 2011; H. Ranasinghe & Ranasinghe, 2015). In chronic kidney disease of known causes, it is usually the glomerulus or blood vessels of the nephron that are damaged; hence, it is also often called as glomerular *nephritis*[11]. However, in CKDu, damage usually occurs to the tubules and interstitial tissues of the nephron, and as such the disease may also be called as *tubular nephritis.*

More than thirty scientific hypotheses have sought to explain the cause/s of the disease (de Alwis & Panawala, 2019), including agrochemical toxicity (Jayasumana, Gunatilake, et al., 2014), dehydration/heat stress (Johnson, 2017), fluoride toxicity (Chandrajith et al., 2011; Ileperuma et al., 2009), heavy metals such as cadmium, arsenic, lead and mercury (Bandara et al., 2010; Jayasumana et al., 2013; Jayasumana, Gajanayake, et al., 2014; Wanigasuriya, K.P. , Peiris-John, R. J. and Wickremasinghe, 2011), and algal toxins (Kulasooriya, 2017). Drinking water, food, and contamination of water sources through rat droppings are some of the possible mediums that spread the disease. However, in public and scientific discourses, contaminated drinking water has dominated as the main medium that would cause CKDu as most scientific studies on CKDu causation are focused on the quality of drinking water (de Silva, 2019; de Silva et al., 2017). The domination of public and scientific discourses by drinking water hypotheses does not mean that other hypotheses do not have a scientific basis. Most of the proposed hypotheses are backed by scientific rationales and may explain the cause of the disease in certain social and geographical settings. However, hypotheses that propose contaminated drinking water, particularly with agrochemicals (mainly glyphosate) have gained significant media attention compared with other hypotheses due to its political sensitivity (Bandarage, 2013).

This paper focuses on drinking water sources that most researchers have proposed as the most likely medium of CKDu causation. In doing so, I particularly focus on the emergence of Reverse Osmosis (RO)-filtered water as a dominant CKDu preventive measure and its domination over rainwater harvesting. The concept of “Appropriate Technology” is used to understand the social, economic, and political implications of drinking water supply mechanisms in relation to CKDu prevention.

First, the paper briefly discusses existing literature on CKDu and its connections with drinking water. In the next section, I will outline fundamental features of the concept of “Appropriate Technology”. This will be followed by a discussion on technologies of supplying ‘safe’ drinking water for communities at risk of CKDu with particular reference to RO-filtration and rainwater harvesting. This discussion draws from the author’s ethnographic fieldwork in Badulupura village in Ginnoruwa Grama Niladhari Division in Mahiyangane, a CKDu-affected rural community in the Uva Province. The paper concludes by highlighting the importance of rainwater harvesting as a simple technological fix that may contribute in abating CKDu effectively in Sri Lanka, compared to technically sophisticated RO-filtering systems.

CKDu and drinking water

There is a lack of accurate epidemiological information indicating the prevalence and spread of CKDu. Even though there has been progress in registering CKDu patients at kidney clinics in government hospitals in affected areas, many patients do not attend clinics due to various practical reasons and most deaths take place at home. As a result, data on the number of people affected by the disease is underestimated and occasionally contradictory (de Silva et al., 2017). However, according to rough estimates, it is reported that the number of CKDu patients in endemic areas was 20,336 by 2013 (Elledge et al., 2014), while according to the Government Medical Officers' Association, there were more than 400,000 people affected country wide. The annual death rate due to CKDu is indicated to be 1400, while around 22,000 may have died over the last two decades (H. Ranasinghe & Ranasinghe, 2015). One of the reasons for this large discrepancy between different estimates of CKDu patients may be the complexity in differentiate between kidney patients who got the disease through known causes i.e. diabetics and hypertension, and the patients whose cause of the disease is none of those already identified causes. Thus, a CKDu patient recognized by one research group may not be recognized as a CKDu patient by another group. This confusion can be enhanced further by misunderstanding other kidney-related diseases with CKDu. For instance, during my fieldwork, I came across with several patients who were having kidney stones, but erroneously categorized as CKDu patients.

The main reason for the domination of polluted water as the main source of CKDu in both scientific and public discourses is that many scientific studies conducted on the issue have proposed possible connections between contaminated water and the disease. As a vast majority of CKDu-affected areas coincide with the areas irrigated under the Accelerated Mahaweli Development Project (AMDP), it is speculated that polluted water distributed through the AMDP is causing the disease. Bandara et al. (2011) argue that pollution of Mahaweli River water and farmlands under irrigation by cadmium from irrigation inputs, mainly contaminated phosphate fertiliser, is a main factor behind the chronic renal failure epidemic among farmers in the region.

A group of scientists from the University of Kelaniya and Rajarata, including Nalin de Silva and Channa Jayasumana, suggested a link between arsenic and hardness of drinking water as a causal agent of CKDu (Jayasumana et al., 2013). Another strong linkage between polluted water and CKDu has proposed by Oliver Ileperuma and scientists at the University of Peradeniya through fluoride toxicity. According to them, when sub-standard aluminium vessels are used to cook and store water with high fluoride contents, there is a greater possibility of forming aluminium-fluoride complexes, which may play a significant role in causing chronic renal failure (Ileperuma et al., 2009). More recently, diverting for a certain extent from their earlier focus on arsenic as the major causal agent of CKDu, Jayasumana and Rajarata University-based scientists insisted that there would be a strong connection between pesticides residues, mainly glyphosate, hard water and CKDu. As they hypothesise, glyphosate, nephrotoxic metals and hard water combine to form complexes that have the potential to destroy renal tissues of humans (Jayasumana, Gunatilake, et al., 2014). In addition to these factors, freshwater sources contaminated by cyanotoxins produced by cyanobacteria (blue green algae) are also proposed as a possible causal agent of CKDu (Kulasooriya, 2017).

Apart from the fact that majority of scientific hypotheses that explain the etiology of CKDu have focused on polluted water as the main medium of disease, the politicised and contested nature of agrochemical-polluted water hypothesis has also contributed to the wider public media attention for CKDu and polluted water discourse. Agrochemical pollution of water became a hot topic in recent presidential election campaigns, for example, former President Maithripala Sirisena's 2015 Election Manifesto (Sirisena, 2015: 30). As a result of the growing public pressure, former President Maithripala Sirisena banned five agrochemicals in 2015 including glyphosate, which is the main active ingredient of Roundup, a commonly used herbicide in agricultural activities in Sri Lanka by then. Moreover, as glyphosate and many other agrochemicals are produced by western multinational corporations like Monsanto, it has been speculated as an 'agrochemical mafia' and 'a crime against humanity' (Jayasumana, 2016a).

The concept of 'bio-media citizenship' (de Silva, 2018) would help to understand how and why polluted water is believed to be the main causal agent of CKDu at public level. According to this concept, affected people and their behavioural patterns construct a politically informed, 'informational bio-citizenship' through the information gained from clinics, media reports, and local health personnel and it opens a door to understand how particular types of information are popularised and readily available for affected people. On one hand, being paddy farmers, most people in the affected areas are closely connected with agrochemicals and irrigation water in their day-to-day life. On the other hand, in most of these affected areas, the hardness of drinking water is relatively high compared with most of the non-affected areas, which have created a common perception among people that the water tastes bitter and may not be safe for drinking. Therefore, it can be assumed that biomedical explanations of CKDu complements with the experiential knowledge of people about water, which has led to an ideological solidarity around the understanding that polluted water is the cause of the disease (ibid).

In most parts of the dry zone, access to safe drinking water, both in terms of quality and quantity, has been a major issue in people's day-to-day life. The risk of getting CKDu in which drinking water is suspected as the main source of causation has made the situation worse. In this context, there is a huge demand for drinking water supplies which are more cost-effective and user-friendly. In the next section, I briefly discuss the concept of "Appropriate Technology" as it would provide some valuable insights to understand better alternative drinking water supply methods.

Appropriate Technology

In parallel with the rising demand for 'safe' drinking water in CKDu-affected areas, a debate has emerged both at village-level and scientific and policy-making circles on what should be the appropriate technology or technologies to meet that demand. How do we decide whether a particular technology is appropriate or not? What criteria may use to define appropriate technologies? The concept of "Appropriate Technology" (AT) would shed some lights to respond to those questions effectively. The term "appropriate technology" is often used synonymously with many terms such as "intermediate technology", "rural technology", "low-cost technology", "alternative technology", "grass-root technology", and "barefoot technology" (Jequier & Blanc, 1983), which has caused a confusion around the exact meaning of the concept. This confusion around the definition of AT can be mainly attributed to changing social, cultural and political circumstances as its context of implementation is crucial (Murphy et al., 2009).

According to Peter Dunn, the fundamental development aims of AT are to improve the quality of life, maximise the use of renewable resources, and create workplaces in the neighbourhoods where people live (Dunn, 1978: 5). In pursuing those aims, AT methods are expected to employ local skills, local material resources and local financial resources, which are compatible with local culture and practices (ibid). Resonating with Dunn's ideas on AT, Murphy et al (2009) points out that AT methods seek to build individual, institutional, economic, and/or governance capacity, while making use of available resources in an environmentally sustainable manner.

For the purpose of this paper, to discuss the appropriateness of techniques which are used to provide 'safe' drinking water for people in CKDu-affected areas, I would focus on some of the main aspects of AT such as sustainability, affordability, local participation, use of local and renewable resources, gender considerations and meet local capabilities. It should be noted that these aspects are related with each other and often, if not always, interdependent. Sustainability has two major elements in terms of AT: environmentally sustainable and locally sustainable (Murphy et al., 2009). The environmental sustainability refers to the point that the use of a technology should not cause significant harm to the environment in which the technology is implemented, and meeting current needs of the community should not comprise the needs of future generations. The use of local and renewable sources is also closely connected with the element of environmental sustainability as it helps to cut down the cost of production and reduce the dependency on outside sources. The second element of locally sustainable means, once a technology is introduced and outside designers left, the local community should be capable of maintaining, reproducing, and repairing (Murphy et al., 2009).

Local participation in the process of design, implementation and maintenance is an essential prerequisite if a technology to be an AT. Without the willful participation of the community in which a technological intervention is exercised, it is merely impossible to make that technology locally sustainable. For instance, as I discuss in this paper, maintenance and follow up plays a key role in ensuring the success of rainwater harvesting. The failure of many rainwater harvesting programs in different parts of the country, which critics like Channa Jayasumana referred to, could be mainly attributed to the lack of maintenance, and follow up. Regarding gender concerns around AT, Murphy et al. point out that it is pivotal as women play a crucial role in new technological interventions as majority of those interventions, particularly in Africa, Asia and Latin America target activities performed by women such as collecting water, gathering firewood, agricultural activities and caring for domestic animals as well as children and elderly people (Murphy et al., 2009).

While achieving sustainable and safe access to drinking water in CKDu-affected areas in the dry zone depends on many socio-economic and ecological factors, appropriate technologies may play an important part in that effort. RO-filtration and rainwater harvesting are two major solutions which have been popular and in practice to address the drinking water issue in the dry zone over the last couple of decades. In the next section, I briefly discuss the status of RO-filtration and rainwater harvesting as means of abating CKDu in Sri Lanka.

RO-filtering versus Rainwater harvesting

Among those who recommend providing safe drinking water as a major preventive measure of CKDu, a vast majority back and promote RO-filtered water as the most appropriate way to address the issue (Jayasumana et al., 2016; Ranasinghe et al., 2015; Wimalawansa Foundation, 2013). According to the Wimalawansa Foundation (2013), other than provision of pipe-borne water by the government and/or private sector involvement or purified water via RO-plants, there is no other sustainable way to provide safe water for CKDu-affected communities and RO is the most cost-effective system that can remove all toxic components from brackish water in affected areas.

Consequently, Wimalawansa Foundation has launched a charity project to install 450 plus RO plants in affected areas which is estimated at around US$4,500,000 (Wimalawansa Foundation, 2013). It is apparent that the government has also paid a special attention towards supplying RO-filtered water for CKDu-affected communities as a major disease preventive measure. According to Harsha Kumar Suriyarachchi, former Vice-Chairman of the National Water Supply and Drainage Board (NWSDB), RO filters can significantly reduce Total Dissolved Solids (TDS) content, which is the main element in brackish water harming those affected by CKDu. As RO filters became popular, in 2013 the government allocated 900 million rupees to purchase RO machines for the worst affected areas (Suriyarachchi, 2014), and there were around 50 large-scale RO machines, 500 middle-scale machines and around 50,000 domestic RO machines in use (Jayasumana, 2016b: 169).

Although Sri Lanka is famous for its ancient hydraulic civilisation which consisted of thousands of large rainwater collecting tanks, at present, compared to RO machines, rainwater harvesting systems are less popular as a preventive measure of CKDu. However, there are several advocates of rainwater as a safe drinking water source for CKDu-affected communities.

As rainwater is almost free from chemicals such as fluoride, calcium and magnesium, according to Stanley Weeraratne, Director of Lanka Rain Water Harvesting Forum, rainwater could be used to reduce the severity and incidence of CKDu (IWMI, 2014). It is reported that more than 30,000 rainwater harvesting systems have been established by the NWSDB, Lanka Rain Water Harvesting Forum and many other private and public institutions (Ariyananda et al., 2010). Rainwater harvesting has been suggested as a simple, practical remedy for those people with renal failures and the lack of attention for rainwater is even attributed to the influence of big companies who produce RO plants (Dharmasena, 2015). One of a few prominent advocates of rainwater harvesting as an effective mean of providing safe drinking water for affected people was the late Ranjith Mulleriyawa, an agriculturalist, farmer, researcher and rural development activist. He founded the Rain Drops Project, which I discuss in the next section, a community-driven rainwater harvesting project, with the aim of providing rainwater for CKDu-affected people in Ginnoruwa.

Rain Drops Project

The Rain Drops Project was initiated under the leadership of Ranjith Mulleriyawa, who was also a member of the Centre for Education, Research and Training in Kidney Disease (CERTKiD) at the University of Peradeniya, with financial support from the Commercial Bank PLC, Sri Lanka, and other well-wishers. The project site was Badulupura, a village in Ginnoruwa Grama Niladhari Division in Mahiyangane, where around 30% of households said to have at least one CKDu patient (Balasooriya et al., 2019). In contrast, in the adjacent village of Sarabhoomi, there was only one positively diagnosed CKDu patient and he too moved there after about 10 years of living in Badulupura.

Both villages were established in 1982, within the Mahaweli C zone, as part of the AMDP. Both villages have their paddy fields located in the same tract of land and growing the same paddy varieties using same agrochemicals. Moreover, food patterns and other lifestyle patterns were also almost similar in both communities. The only obvious difference between the two communities was their topographic difference as Badulupura was in the upper slope of the rolling landscape, whilst Sarabhoomi was located on a relatively flat land in the closer proximity to the bank of Mahaweli River. Until recently, people in Badulupura used shallow dug wells in their homestead as their drinking water sources while

Sarabhoomi villagers use river water from the Mahaweli River (Mulleriyawa, 2016c).
The project began as a pilot project in January 2016 by providing rainwater harvesting facilities for 25 households with CKDu patients, while another 25 households without CKDu patients were studied as the control sample (Mulleriyawa, 2016a, 2016b). The author conducted a brief ethnographic study in between November 2016 and March 2017, mainly focusing on villagers' perceptions on drinking rainwater and its effects on the disease.

Methodology

As noted above, rainwater collecting tanks, each with 5000L storage capacity, were donated to families with at least one CKDu patient in Badulupura village. As a result, by the end of 2016, around 90 people, including both CKDu patients and non-patients, were consuming rainwater for their drinking and cooking purposes for almost one year. As part of my ethnographic study, I conducted semi-structured interviews with 20 people affected by CKDu in Badulupura village in Ginnoruwa Grama Niladhari Division who had received rainwater tanks and 5 people from the same village who had not received tanks at that time. The interviews with patients who received rainwater collection tanks were particularly focused on the taste of water, quantity of water intake, physical features of prepared meals and tea, and health impacts, whilst the interviews with people who did not have those tanks were mainly focused on their perceptions and interest/enthusiasm to consume rainwater for their drinking and cooking purposes.

Apart from those semi-structured interviews, during my stay in the community, I conducted a participant observation of kidney patients, their family members, rainwater tank holders and other villagers. I observed their behaviours, perceptions, and ways in which they expressed their views particularly on CKDu and its relationship with water, rainwater harvesting and RO-filtration, rainwater quality and other matters related to the Rain Drops Project, the CERTKiD group and the Commercial Bank. Most of the times, these observations carried out at community meetings, such as Death Donation Society, Rain Drops Project, and Farmer Organization, at *kadamandiya* (village shop complex), and at community events and functions.

Critical reflections: why rainwater harvesting could be more appropriate compared to RO-filtration?

In his recent book, *Wakugadu Satana (The Battle Against Kidney Disease)*, an ambitious intervention on CKDu issue, Channa Jayasumana vehemently opposes rainwater harvesting approaches and promotes RO machines as the best available option in supplying safe drinking water for disease prone communities (Jayasumana, 2016b). However, my own study at Ginnoruwa poses the opposite view. Commenting on rainwater harvesting, Jayasumana writes,

> "During the dry season, algae and fungi grow on the roof [of the house]; birds and other wild creatures excrete on the roof. Someone could say that collecting water after letting the first few rainfalls wash away/clean the muck on the roof may be a solution for this, but according to villagers it is just bypassing the real problem... within several weeks of collecting water, its taste changes due to the growth of fungi, cyanobacteria and other types of microorganisms (Jayasumana, 2016b: 163). **[The original text was in Sinhala and the English translation was done by the author].**

However, my ethnographic fieldwork in Badulupura disproves Jayasumana's above claim. None of the rainwater users had experience a bad taste in collected water. Moreover, in most households, they were drinking and using rainwater for cooking purposes, with the condition of not using for washing and other purposes, even up to 5-6 months since the time of collection without any shortage of water. In terms of the desire for water, all the people I interviewed were of the view that they are very comfortable with drinking rainwater instead of well water. According to their perception, new practice has increased the amount of daily water intake, and consequently, there is an increase in the volume of urine excreted. Gunadasa and Sumanadasa were siblings, who were 55 years and 63 years old respectively and were in an advanced stage (IV) of kidney disease **[All names of the informants are pseudonyms to protect their privacy].** According to them, there was a clear difference in the taste of rainwater compared with well water, and they felt very comfortable with drinking rainwater. Both claimed that their daily water intake had increased significantly with rainwater, and consequently, passing out a higher volume of urine, in comparison to when they were drinking well water. They haven't come across fungi or algae growth in their tanks either, contrary to the Jayasumana's claims (Field Notes 2017). Jayasumana further argues that,

> […] according to these western pundits- people who are promoting rainwater harvesting as the solution for CKDu and writing articles to newspapers… the suggestion is to collect water through gutters and store in a large, pot-like concrete tank. The Rajarata receives rainfalls only for a limited period of the year and the rest of the time receives intense sunlight." (Jayasumana, 2016b: 163).

However, the Rain Drops Project in Badulupura has shown that this was not as much of a problem as it may seem. My ethnographic observations on families who were using rainwater confirm that a fully filled 5000L rainwater tank was enough for a family with an average of four members to cover their drinking and cooking needs at least up to four months. During the dry season in the field study period (August to December 2016) only three tanks were completely exhausted and there was enough water in other tanks to meet people's water needs. Out of those three empty tanks, one tank was exhausted because of a social function, while in the other two households, they had shared their water with neighbouring families who did not receive rainwater tanks by then (Field Notes 2017).

Referring to the failures of previously established rainwater harvesting systems elsewhere in the country, Jayasumana declares that "These loquacious pundits who advocate rainwater harvesting should understand that although many nongovernmental organizations tried their best to implement it over the last 30 years, it has proved completely unsuccessful." (Jayasumana, 2016b: 163). It is true that many of the rainwater harvesting projects implemented over the last three decades have failed or not up to the expected standards, mainly due to the poor management (Ariyabandu 1999). However, before writing it off, the reasons behind those failures should be deeply studied. The successful experience of the Rain Drops Project in Badulupura shows that if there is a proper maintenance and follow-up, rainwater harvesting could be a viable solution for providing safe drinking water in CKDu-affected areas.

It may not be possible to derive conclusions on CKDu preventive measures from the results of a one-year pilot intervention, which is relatively a short period of time compared to the time takes to manifest CKDu. However, I would contend that there are several important ethnographic observations and findings of the Rain Drops Project that may contribute to establish rainwater as an effective preventive approach in mitigating CKDu in the long run.

One such observation is the zero identification of new patients from the group who were drinking rainwater. During the pilot project, on 31st of March 2016, a screening clinic was conducted in the village by Girandurukotte Base Hospital and thirteen new patients were identified. Importantly, all those newly identified patients were from families who were drinking well water, and no one was identified from families who were in the test sample consuming rainwater for drinking and cooking purposes. Moreover, in one hand, many patients, and people, both men and women, who were drinking rainwater, did not experience burning sensation after urination even in the dry season as they previously experienced when consuming well water. On the other hand, there were still many users of well water who felt burning sensation when urinating in the dry season.

Another effect of the use of rainwater for cooking instead of well water was the positive improvement in appetite. As per several female participants, when they cooked with rainwater instead of well water, they felt a very clear difference in the physical appearance and texture, as well as the quality of meals which are more delicious. Moreover, when they prepared tea with well water, there was an oily film on the tea, which also had a bad taste. However, when rainwater was used to prepare tea, this was not the case. As Malini put it,

> "Tea is the main drink in our culture… we have tea at least three, four times per day. With well water, we didn't feel the real taste of tea and there was like an oily surface in the tea. But when prepared with rainwater, tea is clear and tastes much better" (Field Notes 2017).

Two main aspects of AT are sustainability and the use of renewable sources. In that sense, it is obvious that rainwater harvesting is much better compares to RO filters. In rainwater harvesting, water is collected from natural rainfalls and directly utilised, whereas in RO filtration, the contaminated groundwater is artificially filtered after releasing concentrated toxic waste back into the environment. As RO filtering technologies are more sophisticated, it requires changing filters frequently and continuous maintenance which is very expensive. On the contrary, rainwater harvesting involves simple and user-friendly technology, and it can be maintained at a low cost by any villager. Further, the plastic tanks used in the Badulupura project were guaranteed for minimum of 10 years by the company that produced it. Moreover, for the operation of RO filters, a continuous supply of electricity is required, while rainwater harvesting does not require this at all.

However, in terms of the cost-effectiveness, it should be noted that the initial cost of installing a rainwater harvesting system for an individual household is relatively high. In Badulupura, in 2016, it was around 70,000 rupees. It can be argued that, from an economic perspective, it would be difficult for affected villagers, given their relatively low socio-economic background, to afford the initial cost of rainwater harvesting system, thus it is not economically viable option. Undoubtedly it is a valid argument, and it should be taken into consideration before recommending rainwater harvesting as an effective CKDu prevention strategy. However, it should also be noted that there are different ways to address this financial hindrance. For instance, in addition to providing rainwater harvesting tanks for free, government or philanthropic organizations may encourage tank receivers also to contribute through either financially and/or labour. Interestingly, such programs have already implemented in some other parts of the country (Ariyabandu, 1999).

In many developing countries, women are mainly responsible for collecting, transporting and managing water for domestic purposes including drinking and cooking (Upadhyay, 2005). A similar type of relationship between women and domestic water use can be found in Ginnoruwa and many other rural areas in Sri Lanka as well. Having a rainwater collection tank on the doorstep would significantly reduce the burden of women in terms of time and labour. This was confirmed by many women in Badulupura who received rainwater tanks from the Rain Drops Project. For instance, Karunawathi, a tank holder in the first round of the Project, happily shared with me, "My sister, who is living in Dehiattakandiya, needs to travel 2km daily to the RO plant to bring water. If it is not for this Project, we may also have to do the same" (Field Notes 2017). As it is evident in Karunawathi's statement, this is not the case in relation with large RO plants. Women may still need to walk long distances or travel by other modes such as bicycle or motor bike or trishaw to where the RO plant is located and collect and bring water in large amounts making their quotidian life more complicated and troublesome.

Conclusion

CKDu is considered to be a burning public health issue in Sri Lanka at present, but the etiology of the disease is yet to be scientifically confirmed. There have been more than thirty scientific hypotheses proposed to explain the etiology of CKDu and both scientific and public discourses on CKDu are dominated by the discussions around polluted water. This has led to significant lifestyle changes around water consumption patterns of people by creating a fear of the water they traditionally used. Contaminated water is suspected as the main factor that cause CKDu, and therefore, the provision of "pure", "safe" drinking water for CKDu patients and people in affected areas has accepted as a major preventive measure in abating CKDu by all stakeholders including state authorities, NGOs and philanthropic organisations. Following this line of thinking, over the last two decades, there have been many efforts and interventions taken place to provide "safe" drinking water, mostly focused on RO-filtered water.

The literature on Appropriate Technology emphasises the importance of focusing on sustainability, affordability, local participation, use of renewable resources, gender considerations and meeting local capabilities when selecting one technology over the other. Based on these factors, in this paper, I have argued that compared to RO-filters, rainwater harvesting may be a more appropriate approach in providing "safe" drinking water for CKDu-affected communities in the dry zone of Sri Lanka. My ethnographic study of the Rain Drops Project and its impacts on CKDu-affected Badulupura community indicates that if there is proper maintenance and follow up, and a supportive system to afford the financial cost, rainwater harvesting is likely to be effective and successful.

Ethnographic observations of Badulupura on consuming rainwater instead of well water tend to suggest that there is a correlation between switching from well water to rainwater and reduction in the spread of the disease. However, those positive impacts in terms of disease burden may not necessarily be due to the consumption of rainwater, but due to something else. Thus, further biomedical studies are required to confirm that the consumption of rainwater causes the reduction in CKDu disease burden. What these ethnographic observations do confirm is almost all the people who use rainwater instead of well water feel comfortable doing so and have enhanced their intake of water. However, before generalising these findings, it is necessary to conduct further studies in different social, economic and environmental contexts. Only then it can be known whether there are any context-specific factors that may explain the success or failure of rainwater harvesting systems as an appropriate technology over RO-filtration, and an effective CKDu prevention strategy.

Acknowledgement

I would like to remember the late Ranjit Mulleriyawa for his determination and immense courage to support CKDu-affected people by initiating the Rain Drops Project in Badulupura. Moreover, I acknowledge the Commercial Bank PLC, ETC Lanka(Pvt) Ltd, the CERTkiD group at University of Peradeniya, Ms Wasantha Pathirana, Ms Anusha Pushpamali and others at Badulupura for their contribution in establishing and running the Rain Drops Project and facilitating my fieldwork there. My special thanks to Dr. Tom Widger at the University of Durham, for his invaluable comments on this paper.

References

Ariyabandu, R. de S. (1999). Problems and Prospects of Rainwater Catchment for the 21st Century Sri Lanka. 9th International Rainwater Catchment Systems Conference. http://www.eng.warwick.ac.uk/ircsa/9th.html

Ariyananda, T., Wickramasuriya, S., & Wijeyesekera, D. (2010). Rain Water Harvesting for Water Efficiency and Management. International Conference on Sustainable Built Environment (ICSBE-2010). http://www.civil.mrt.ac.lk/conference/ICSBE_2010/vol_02/26.pdf

Athuraliya, N. T. C., Abeysekera, T. D. J., Amerasinghe, P. H., Kumarasiri, R., Bandara, P., Karunaratne, U., Milton, A. H., & Jones, A. L. (2011). Uncertain etiologies of proteinuric-chronic kidney disease in rural Sri Lanka. Kidney International, 80(11), 1212–1221. https://doi.org/10.1038/ki.2011.258

Balasooriya, S., Munasinghe, H., Herath, A. T., Diyabalanage, S., Ileperuma, O. A., Manthrithilake, H., Daniel, C., Amann, K., Zwiener, C., Barth, J. A. C., & Chandrajith, R. (2019). Possible links between groundwater geochemistry and chronic kidney disease of unknown etiology (CKDu): an investigation from the Ginnoruwa region in Sri Lanka. Exposure and Health, 0123456789. https://doi.org/10.1007/s12403-019-00340-w

Bandara, J. M. R. S., Wijewardena, H. V. P., Bandara, Y. M. A. Y., Jayasooriya, R. G. P. T., & Rajapaksha, H. (2011). Pollution of River Mahaweli and farmlands under irrigation by cadmium from agricultural inputs leading to a chronic renal failure epidemic among farmers in NCP, Sri Lanka. Environmental Geochemistry and Health, 33(5), 439–453. https://doi.org/10.1007/s10653-010-9344-4

Bandara, J. M. R. S., Wijewardena, H. V. P., Liyanege, J., Upul, M. A., & Bandara, J. M. U. A. (2010). Chronic renal failure in Sri Lanka caused by elevated dietary cadmium: Trojan horse of the green revolution. Toxicology Letters, 198(1), 33–39. https://doi.org/10.1016/j.toxlet.2010.04.016

Bandarage, A. (2013). Political economy of epidemic kidney disease in Sri Lanka. SAGE Open, 3(4). https://doi.org/10.1177/2158244013511827

Chandrajith, R., Nanayakkara, S., Itai, K., Aturaliya, T. N. C., Dissanayake, C. B., Abeysekera, T., Harada, K., Watanabe, T., & Koizumi, A. (2011). Chronic kidney diseases of uncertain etiology (CKDue) in Sri Lanka: Geographic distribution and environmental implications. Environmental Geochemistry and Health, 33(3), 267–278. https://doi.org/10.1007/s10653-010-9339-1

de Alwis, A. A. P., & Panawala, P. V. S. (2019). A review of the national response to CKDu in Sri Lanka. Sri Lanka Journal of Social Sciences, 42(2), 83–100. https://doi.org/10.4038/SLJSS.V42I2.7966

de Silva, M. W. A. (2018). Bio-media Citizenship and Chronic Kidney Disease of Unknown Etiology in Sri Lanka. Medical Anthropology: Cross Cultural Studies in Health and Illness, 37(3), 221–235. https://doi.org/10.1080/01459740.2017.1311886

de Silva, M. W. A. (2019). Drinking water and chronic kidney disease of unknown aetiology in Anuradhapura, Sri Lanka. Anthropology and Medicine, 26(3), 311–327. https://doi.org/10.1080/13648470.2018.1446822

de Silva, M. W. A., Albert, S. M., & Jayasekara, J. M. K. B. (2017). Structural violence and chronic kidney disease of unknown etiology in Sri Lanka. Social Science and Medicine, 178, 184–195. https://doi.org/10.1016/j.socscimed.2017.02.016

Dharmasena, C. (2015). Rainwater: A quick remedy for kidney disease. The Island Online. https://island.lk/?page_cat=article-details&page=article-details&code_title=123806

Dunn, P. (1978). Appropriate Technology: Technology with a Human Face. The Macmillan Press.

Elledge, M., Hoponick Redmon, J., Levine, K., Wickremasinghe, R., Wanigasariya, K., & Peiris-John, R. (2014). Chronic kidney disease of unknown etiology in Sri Lanka: Quest for understanding and global implications. RTI Press Research Brief, March, 1–90. ftp://ftp.fao.org/codex/meetings/CCCF/cccf5/cf05_INF.pdf%5Cnhttp://www.rti.org/publications/rtipress.cfm?pubid=22766

Ileperuma, O. A., Dharmagunawardhane, H. A., & Herath, K. P. R. P. (2009). Dissolution of aluminium from sub-standard utensils under high fluoride stress: A possible risk factor for Chronic renal failure in the North-Central Province. Journal of the National Science Foundation of Sri Lanka, 37(3), 219–222. https://doi.org/10.4038/jnsfsr.v37i3.1217

IWMI. (2014). Increasing Sri Lanka's rainwater storage will help protect people from floods and droughts. International Water Management Institute. https://www.iwmi.cgiar.org/2014/10/ increasing-sri-lankas-rainwater-storage/

Jayasumana, C. (2016a). Supporting chemical industries and obstructing research on CKD a crime against humanity. Daily FT. https://www.ft.lk/article/577788/Www.aquavista.lk

Jayasumana, C. (2016b). Wakugadu Satana (The Battle against Kidney Disease). Sarasavi Publishers.

Jayasumana, C., Gajanayake, R., & Siribaddana, S. (2014). Importance of Arsenic and pesticides in epidemic chronic kidney disease in Sri Lanka. BMC Nephrology, 15(1), 1–5. https://doi.org/10.1186/1471-2369-15-124

Jayasumana, C., Gunatilake, S., & Senanayake, P. (2014). Glyphosate, hard water and nephrotoxic metals: Are they the culprits behind the epidemic of chronic kidney disease of unknown etiology in Sri Lanka? International Journal of Environmental Research and Public Health, 11(2), 2125–2147. https://doi.org/10.3390/ijerph110202125

Jayasumana, C., Paranagama, P. a., Amarasinghe, M. D., Wijewardane, K. M. R. C., Dahanayake, K. S., Fonseka, S. I., Rajakaruna, K. D. L. M. P., Mahamithawa, A. M. P., Samarasinghe, U. D., & Senanayake, V. K. (2013). Possible link of Chronic arsenic toxicity with Chronic Kidney Disease of unknown etiology in Sri Lanka. Journal of Natural Sciences Research, 3(1), 64–73. http://www.iiste.org/Journals/index.php/JNSR/article/view/4193

Jayasumana, C., Ranasinghe, O., Ranasinghe, S., Siriwardhana, I., Gunatilake, S., & Siribaddana, S. (2016). Reverse osmosis plant maintenance and efficacy in chronic kidney disease endemic region in Sri Lanka. Environmental Health and Preventive Medicine, 21(6), 591–596. https://doi.org/10.1007/s12199-016-0580-9

Jequier, N., & Blanc, G. (1983). The World of Appropriate Technology: A Quantitative Analysis. Development Centre of the Organisation for Economic Co-operation and Development.

Johnson, R. J. (2017). Pro: Heat stress as a potential etiology of Mesoamerican and Sri Lankan nephropathy: A late night consult with Sherlock Holmes. Nephrology Dialysis Transplantation, 32(4), 598–602. https://doi.org/10.1093/ndt/gfx034

Kulasooriya, S. A. (2017). Toxin producing freshwater cyanobacteria of Sri Lanka. Ceylon Journal of Science, 46(1), 3. https://doi.org/10.4038/cjs.v46i1.7413

Mulleriyawa, R. (2016a). A Raindrops project- a community-based approach to understand and resolving CKDu problem. The Island. http://cea.nsf.ac.lk/bitstream/handle/1/18076/E_2016_APR_24_SUNDAY_ISLAND.pdf?sequence=1&isAllowed=y

Mulleriyawa, R. (2016b). Living among CKDu patients. Daily News. http://www.dailynews.lk/2016/01/06/features/living-among-ckdu-patients?page=3

Mulleriyawa, R. (2016c). Most likely cause of CKDu: compelling evidence from the field: Rooted in troubled waters. Daily News. https://dailynews.lk/2016/08/05/features/89540

Murphy, H. M., McBean, E. A., & Farahbakhsh, K. (2009). Appropriate technology - A comprehensive approach for water and sanitation in the developing world. Technology in Society, 31(2), 158–167. https://doi.org/10.1016/j.techsoc.2009.03.010

Ranasinghe, H. R. A. L. N., Lokuge, L. D. M. N., Edirisinghe, J. C., & Bandara, L. (2015). Water Treatment, Preventive Measures and the Chronic Kidney Disease in the Farming Community in Sri Lanka. Journal of Agricultural Sciences, 10(2), 98. https://doi.org/10.4038/ jas.v10i2.8055

Ranasinghe, H., & Ranasinghe, M. (2015). Status, Gaps and Way Forward in Addressing the Chronic Kidney Disease Unidentified (CKDu) in Sri

Lanka. Journal of Environmental Professionals Sri Lanka, 4(2), 58–68. https://doi.org/10.4038/jepsl.v4i2.7863

Sirisena, M. (2015). A Compassionate Maithri Governance: A Stable Country. https://groundviews.org/wp-content/uploads/2014/ 12/MS-2015.pdf

Suriyarachchi, H. (2014). Is reverse osmosis (RO) treatment the answer to solving the CKDu riddle? IWMI. https://www.iwmi.cgiar.org/ 2014/10/reverse-osmosis-ro-treatment-answer-solving-ckdu-riddle/

Upadhyay, B. (2005). Gendered livelihoods and multiple water use in North Gujarat. *Agriculture and Human Values*, *22*(4), 411–420. https://doi.org/10.1007/s10460-005-3396-6

Wanigasuriya, K.P. , Peiris-John, R. J. and Wickremasinghe, A. R. (2011). Chronic kidney disease of unknown aetiology in the North Central Province of Sri Lanka: trying to unravel the mystery. *The Ceylon Medical Journal*, *56*(4), 143–146. https://doi.org/10.4038/cmj. v56i4.3891

Wimalawansa Foundation. (2013). *Cost-Effective Solutions for Safe, Pure Drinking Water*. https://wimalawansa.org/community_projects/ water_sanitation_and_kidney_disease