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Post 'Rathupaswala Issue': Neighbouring community perceptions of groundwater

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Abstract: In the recent past a huge community upheaval claiming one human life was witnessed in the Gampaha district of Sri Lanka due to the quality of drinking water obtained through groundwater. This unfortunate occurrence was based on perceived negative information on water quality by the community in the area. The incident is well published in the media as the 'Rathupaswala Issue'. Propaganda given for such events also impact communities in the surrounding areas and could be a driving force to change community perceptions on the quality of their drinking water. In this scenario, this study was undertaken to investigate the impacts of the incident on the public perceptions in the nearby communities on their drinking water sources. The methodology of the study is based on household interviews backed by water sample tests for important parameters. The data analyses using statistical methods helped draw conclusions on the association of community perceptions with the issue, and the analyses of experimental data helped identify underlying plausible scientific reasons for such perceptions.

Keywords: Public perceptions, drinking water, sources of water, water treatment, Rathupaswala

1. Introduction

Safe drinking water is essential for humans. The safety of water is established considering its physical, chemical and biological parameters. While most chemical and biological parameters can be established only through field or laboratory tests, the general public is able to understand the physical parameters such as colour, odour and taste by their own sensory evaluations.

Public acceptance of a water source depends on the perceptions they form, mostly based on the physical characteristics of water drawn from the source. Nonetheless, such perceptions are also braced by other external factors such as economy, demography, scientific discoveries and socio-economic dynamics such as media, neighbourhood trends and political trends. Consequently, these perceptions are bound to vary with the changes in such factors based on scientific knowledge as well as non-scientific factors.

In 2013, such a change in public perceptions which led to a huge social upheaval was reported in 'Rathupaswala' of Gampaha district, Sri Lanka. The cause for this changed perception was a scientific discovery; acidity of water samples tested. This discovery originated due to a suspicion arose on the water quality of a dug well of a temple nearby a latex glove manufacturing factory located in Rathupaswala. Public believed that the cause of acidity in groundwater was the factory effluent. The social upheaval attracted substantial attention from the media. It is alleged that not only the people who lived in the vicinity of the factory, but also those who lived a considerable distance away have changed their perception of the quality of groundwater with this incident.

As such, the aim of this research is to examine the extent to which this issue has affected the perceptions of groundwater as a sources of drinking water, in the neighbouring areas of the incident.

This aim is met by studying the following two broad research questions using a sample of households situated between 3 km to 7 km from the point of issue.

a) How did the public react to the issue with regard to their drinking water?
b) What scientific evidences are available to educate the communities in the area?

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2. Rathupaswala Issue

This section elaborates the background of the incident and the scope of the current research with respect to the study area.

2.1 Background

Rathupaswala is a village located in the Gampaha District of Sri Lanka with coordinates 7.0582° N, and 80.0172° E. Being situated in an industrialised zone, a Latex Glove manufacturing factory had been installed at Rathupaswala since 1997. In 2013 this controversy occurred due to low pH values observed in the water samples taken from boreholes (dug-wells) in the vicinity of the factory. The immediate reaction of the local community was to believe that the chemical waste disposal system of the nearby Latex glove manufacturing factory is at fault and is the cause of the observed low pH values. A huge social upheaval occurred resulting in the death of a person and the forced relocation of the factory away from the area in February 2014. The data for this research study was collected from January 2015 to May 2016.

The sources of potable water for the people of Gampaha district include both groundwater and pipe borne water. Some descriptions of the pipe borne and natural water sources of the district are already available in literature [1, 2]. Accordingly, river Attanagalu Oya is the major source for piped water supply schemes around the Gampaha town and its suburbs.

2.2 Study area

The study intends to investigate the perceptions of the quality of their groundwater sources, as held by the public in areas near Rathupaswala. It also intends to investigate the impact of the Rathupaswala issue on such perceptions. Therefore, an area lying between 3 km – 7 km from the questionable latex glove manufacturing factory was selected for the study (Figure 1)[3].

Figure 1 illustrates the factory location and two circles of 3 km and 7 km radii from the factory location [3]. The selected study location is indicated between the two circles. It is worthwhile to note that the study area has been marginally changed here from the previous publications related to the early phase of this study.

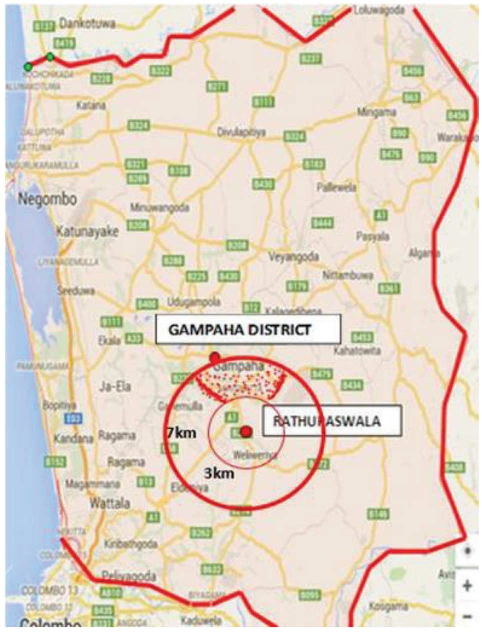

Figure 1 - Study area (Source: adapted from Google maps)

3. Literature Review

Research has been conducted internationally on drinking water, especially to understand the perceptions of communities [4]. Accordingly, there are many sources for drinking water and for water use in households, of which the basic sources may be surface water bodies and underground water bodies. However, the quality of water from such sources is perceived differently by communities depending on their experiences. The following sections present some of the previous research findings on which the present study has been developed.

3.1 Community Perceptions of water

The public's perceptions of the quality of water that they use are usually established on organoleptic characteristics of water such as turbidity, colour, odour and taste. It is not uncommon for communities to reject their aesthetically unappealing water even though the chemical and bio-chemical parameters are within acceptable limits [5]. Further, a study from Bangladesh claims that community perception of drinking water is affected by demographic factors such as gender, age, education, income level and occupation [6].
With time the perceptions held by a community of a particular source of water can be changed due to factors such as transformation of natural and urban environment, sanitary issues, scientific discoveries, socio-economic dynamics and technological innovation [7].

Nonetheless, the perceptions formed by the community on the quality of their sources of water could differ from the actual measured water quality parameters. This could especially occur when such perceptions are based on non-scientific factors. The undertaking of scientific research, which examines relevant water quality parameters, is one of the methods for addressing this issue. Such research has been carried out elsewhere in the world [8].

3.2 Commonly Examined Water Quality Parameters

The suitability of water for different purposes such as drinking, agriculture etc. is scientifically established using different measurable parameters [9]. Standards of such parameters and their allowable ranges are maintained by national and international organisations which have a mandate to do so [5, 10].

A common factor in many scientific explorations (including investigations by households, industries, and researchers) of water quality issues is the testing of limited, pre-determined parameters [8, 11]. It is common for parameters to have been chosen for achieving specific objectives, perhaps due to time and cost constraints faced by the investigator. However, it can be also observed that some basic parameters such as pH which is a measure of the level of acidity (range: 0 - <7) or alkalinity (range: >7 – 14) are usually commonly tested [2]. While the neutral value is 7, water which has a pH range between (6.5-8.5) is deemed potable provided that the other parameters are within their acceptable ranges [9]. Literature has well recorded the implications of drinking water which has pH values out of the above range including aggravated existing skin conditions, neurological and reproductive problems such as seizures, hearing loss and miscarriages [12].

3.3 Previous Local Studies

Local research literature reveals that a number of studies have been conducted on groundwater quality and that further studies are being conducted at present. Early studies in the dry-zone areas have detected the presence of excessive levels of 'Fluoride' in the groundwater of those areas [13]. The Fluoride concentration was attributed to geological formations including granitic gneiss, hornblende biotite gneiss, and biotite gneiss [14]. Further, many research studies and water sampling tests are being carried out in the dry zone areas of Sri Lanka [13, 15] due to the prevailing uncontrollable spread of Chronic Kidney Disease of unknown aetiology (CKDu), which is beyond the scope of the present study.

Within Gampaha District, a few studies had been conducted on the quality of groundwater. Among them, a study [1] conducted in 2009, which encompasses Gampaha district, states that pH values of shallow waters in the Aththanagalu river basin change unevenly. Further it claims that shallow water has become acidic in some areas: Naiwala, Minuwangoda, Ekala, Henegama, Walpola, Pahala Imbulgoda, Weediyawaththa, Henarathgoda and Weliweriya [1]. 'Rathupaswala', the area in which the incident occurred, is in the middle of Pahala Imbulgoda, Henarathgoda, and Weliweriya areas.

Botheju and Abesinghe [16] states that studies conducted after the incident indicates the main cause for low pH have been natural contaminations of groundwater. Another study [17] in which water samples have been tested, finds that there is no clear evidence to link factory effluents to the low pH of the area. Further the same study claims the area consists of Lateritic soil generally which has the pH range of 4.8-6.5 [17].

4. Research Framework

In order to meet the research objective an exploratory research framework was designed consisting of two main components; a household survey and testing water samples for water quality parameters. Brief descriptions of both components together with methods of data analyses are presented in the sub-sections below.

4.1 Household survey

A stratified convenience sample of 105 households within 3 km - 7 km distance was selected for the household survey. The stratification was based on the accessibility of water sources to households. There are three strata or three different types of user groups:

- Group A - Those who have access to groundwater only;
- Group B - Those who have access to pipe borne water only;
- Group C - Those who have access to both groundwater and pipe borne water.

Thus, the sample consisted of households in the villages of Indigolla East, Ihalagama East, Yakkala West, Bandiyamulla East and Kidagammulla areas. The initial selection included 35 households from groups A and C each, and 32 households from group B. For the purpose of this study the Group B acts as the neutral group since they consume treated pipe borne water and does not depend on groundwater.

The instrument for the survey was a pre-developed questionnaire. In its development, the questionnaire was tested with a pilot study conducted among six households to verify its adequacy. In the pilot study, each group A, B and C were represented by two households. The pilot study resulted in improving the efficiency of the survey tool in terms of clarity, flow and the ability to capture in-depth details.

During the survey a key member of each household was individually interviewed by the researchers. The questionnaire carried several sections including personal beliefs regarding water; sources of water; in-house treatment of water; impact of the 'Rathupaswala issue' and knowledge on water quality parameters. Additionally, basic demographic data such as age, gender and education level were also included. In addition to the interview on the structured questionnaire, a further discussion session was conducted for the respondents to freely voice their opinions and experience with regard to the Rathupaswala issue and other water quality issues.

4.2 Water Quality Tests

Water quality tests were conducted on fourteen (14) water samples. Out of them ten (10) samples were obtained representing the interviewed households. These samples were tested for ten (10) parameters which included pH and Alkalinity tests. Out of the above ten water samples, three were from the piped water supply and seven were from boreholes (dug-wells). Four additional samples were obtained outside the study area, but closer to the Rathupaswala factory (i.e. from the 0 to 3 km range). They were tested for pH values only. All samples were collected under the instructions of a qualified senior Government Chemist and the tests for water quality parameters were performed in a laboratory which belonged to a government institution.

4.3 Methods of Data Analyses

Statistical analyses were used for analysing the data collected through interviews. Simple percentages, histograms, pie charts and bar charts were used for descriptive analyses. Further, hypothesis test was used to infer population behaviour. For example, some questions elicited direct answers of the type 'yes' or 'no'. In such situations the sample behaviour was found using simple percentages while the inferences on the population were drawn using hypotheses testing on Binomial distributions. The results of the water quality parameter tests were qualitatively and quantitatively analysed.

5. Data Analyses

This section presents the analyses of data collected through the household survey and the water sample tests. The return rate of the household survey questionnaire was 97% due to the mode of conduct of the survey; i.e. the survey was conducted by visiting each household in person.

5.1 Respondent Composition

The respondents' demographic data are presented in Tables 1 and 2.

Table 1 - Gender and Age distribution of respondents

Group	Gender		Age groups (years)			
	Male	Female	18-30	> 30 - 40	> 40 - 60	> 60
A	17	18	12	6	13	4
B	15	17	4	11	14	3
C	18	17	4	7	17	7
Total	50	52	20	24	44	14
% Total	49	51	20	23	43	14

Respondents were almost equally distributed between the two genders (Male 49%, Female 51%) as shown in Table 1. The distribution of age is skewed with 43% of them in the category of '40-60 years of age' and another 14% in the category of 'above 60 years of age', making majority (57%) respondents over the age of 40 years.

All respondents had received secondary or tertiary level education. Majority (54%) of the sample had received an education beyond secondary level; either Bachelor/higher degrees or qualifications at tertiary level (Table 2).

Table 2 - Education levels of respondents

Group	I	II	III	IV	V	Total
A	0	0	16	12	7	35
B	0	0	18	10	4	32
C	0	0	13	16	6	35
Total	0	0	47	38	17	102
% Total	-	-	46	37	17	

Key:
I – No formal education
II – Primary education (up to Grade 5) only
III – Secondary education (Grades 6-13) only
IV – University education
V – Other tertiary education

5.2 Impacts of the 'Rathupaswala' Issue

The reactions to the issue by the community of the selected study area were assessed using the gathered data (Tables 3, 4, 5 and 6). The data collected included the awareness of the respondents regarding the Rathupaswala issue, their changed behaviours on drinking water after the issue, and the possible reasons for such changes.

Table 3 gives the number of respondents who were aware of the 'Rathupaswala issue' and those who believe that the issue has impacted their personal water sources.

Table 3 - Awareness and beliefs of respondents

	Group A		Group B		Group C		Total	
	Yes	No	Yes	No	Yes	No	Yes	No
Aware of the issue	33	2	30	2	31	4	94	8
Believed impacted	7	20	6	20	2	26	15	66

Accordingly, 94 (92%) of the total respondents were aware of the issue. However, only 9 (7 from Group A and 2 from Group C) out of the total 70 respondents who have access to groundwater believed that their water sources were impacted due to the factory effluent. Of the groundwater users 46 (65.7%) firmly believe that their groundwater sources are not impacted.

The above belief of the respondents on drinking water source after the issue was verified by analysing data collected on changes of water sources and on in-house treatment methods after the Rathupaswala issue (Table 4).
Accordingly, only 4 respondents who have access to groundwater have changed their water source while 10 respondents have changed their in-house water treatment method. Interestingly, some respondents of group B, who at the time of data collection had no access to direct groundwater, too have changed their source (n=4) and in-house treatment methods (n=1).

Table 4 – Changes in source and treatment

Group	Source		Treatment	
	Yes	No	Yes	No
A	1	34	3	31
B	4	28	1	26
C	3	32	7	28
Total	8	94	11	85

Further, discussions with those respondents revealed that they had been using direct groundwater before the Rathupaswala issue and they have abandoned their domestic wells by fully closing or filling them. Hence they are currently within the Group B. Therefore, the total number of changes post-Rathupaswala issue, in the source is 8 households while changes in the in-house water treatment methods is 11 households.

Next, the researchers attempted to establish plausible reasons for these behaviours. The respondents (n=8) who had changed their sources were provided with 3 reasons and those who had not changed (n=94) were provided with 2 reasons. Their agreement for those reasons (allowed to agree on multiple reasons, when applicable) were elicited on a 3-point scale (Agree- A; neutral/No response – N; Disagree – D) as illustrated in Tables 5 and 6.

Table 5 – Reasons for changing source

Reason	A	N	D
Negative media publicity	5	1	2
Neighbours influence	5	0	3
Water Sample test results (+ve)	4	2	2

Accordingly, the respondents justified their decisions citing socioeconomic dynamics such as neighbours and media, while reports of water sample tests had also been another reason.

Table 6 – Reasons for not-changing source

Reasons	A	N	D
Water Sample test results (-ve)	29	28	37
Had no proof to believe poor water quality	33	34	27

The majority (n=94) of the sample have not changed their water sources. The largest group (n=33) cited that they had no proof to consider the need for changing their water source, and the next group (n=29) had tested their water

sources and found nothing abnormal in the test reports.
The following hypothesis is framed to infer the impact of the Rathupaswala issue on the population of the study area.

H0: The Rathupaswala issue has impacted more than 25% of the population by forcing them to change either their water source or the treatment method.

H1: The Rathupaswala issue has impacted not more than 25% of the population by forcing them to change either their water source or the treatment method.

The responses by the sample of respondents are dichotomous and hence binomially distributed. The hypothesis test performed on the distribution rejects the null hypothesis at 95% significance level. Hence it can be inferred that at least 1/4th of the community of the selected area have been affected by the issue.

5.3 Perceptions on contributory factors

The household survey was conducted in an area neighbouring the Rathupaswala issue. Their decisions for changing the source or the in-house treatment methods depend on the awareness of related factors. Hence two such factors (i.e. pH value and the distance between the factory and their dug-well) that could contribute to polluting their groundwater sources were presented to the respondents for their agreement/disagreement as discussed below.

5.3.1 Perceptions of pH Value

The issue of Rathupaswala stemmed from low pH values observed in some water samples obtained from the vicinity of the factory. Therefore, the research was designed to capture the knowledge of the respondents about the water quality parameter, pH value. The question 'Do you know the meaning of pH value in a solution' received the responses as shown in Figure 2. The majority (n=66; 65%) of respondents claimed that they were aware of the meaning of 'pH value'. Some of them were also aware of the health issues caused by low pH presence in the water, such as eye irritation, skin irritation, etc.

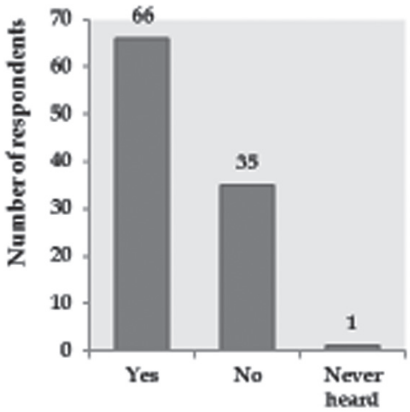

Figure 2 - Responses received for the questions which evaluate their knowledge on pH value

5.3.2 Perceptions of the cause of the issue

Notwithstanding the general knowledge on pH value, the awareness of the sample respondents was elicited on the cause of the issue. The question 'What is the cause of the Rathupaswala issue?' accompanied four choices for answers; high pH, low pH, cannot remember and Do not know. Figure 3 illustrates the number of responses in each of these categories

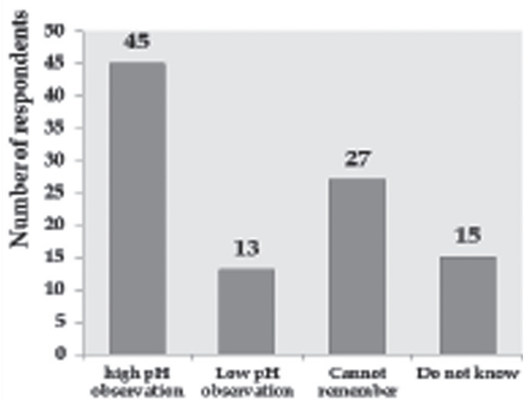

Figure 3 - Responses received for the enquiry of the cause for the Rathupaswala Issue

5.3.3 Impact of Distance

Distance between the source of pollution and the point of use is an important parameter in groundwater contamination. Therefore, the community perceptions of the impact of distance to locations with revealed issues were elicited with the statement "Distance is inversely proportional to impact". The responses were collected on a 3-point response scale (Agree/Neutral/Disagree) (Figure 4).

Respondents who were aware of the impact of distance in the groundwater flow is 70% while only 9% has a negative belief. However, from the collected data it was found that only 52 (51%) of the sample knew the accurate distance to their water source from the factory.

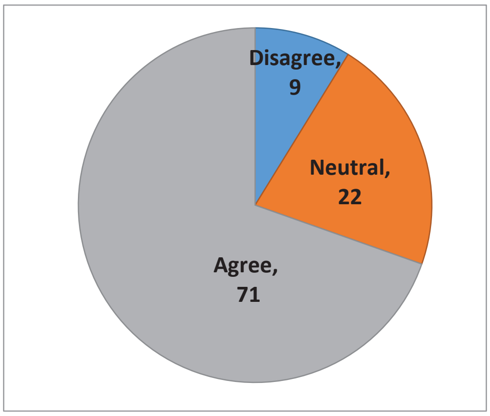

Figure 4 - Responses received for the statement "Distance is inversely proportional to impact"

5.3.4 Perceptions of water quality tests

The survey responses revealed that 36 respondents had tested their water at some time in the past irrespective of Rathupaswala issue. These responses clearly indicate that the majority (n=23) had been interested in checking pH value only (Figure 5). This indicates the general community perception of the area.

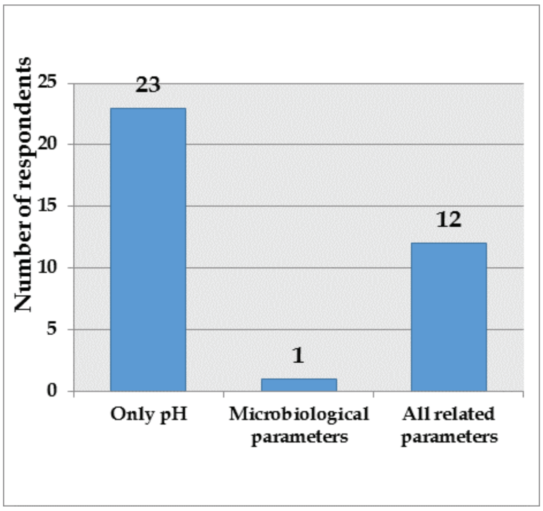

Figure 5 - Types of water quality tests

5.4 Sample Tests for Water Quality

Ten water samples were obtained representing the sample of 102 households. Of them 7 (BH-S1 to BH-S7) represented Groups A and C and were borehole water samples. The remaining 3 samples were obtained from pipe borne water representing Group B households. All these samples were tested for 10 parameters. However, this paper is limited to a discussion on observed pH values. Additionally, 4 groundwater samples (AD-S1 to AD-S4) were collected from locations closer to the glove factory. These were tested only for pH values.

All three pipe borne water samples returned a pH value of 6.8 when tested. The results of pH tests of all 11 borehole samples are shown in Table 7 together with the distance to the factory from the location of the sample collection point.

Table 7 – Results of pH tests of groundwater samples

Sample	pH (at 30^0 C)	Distance (km)
BH-S1	6.2	4.8
BH-S2	5.4	4.54
BH-S3	5.3	4.43
BH-S4	5.0	4.32
BH-S5	5.3	4.92
BH-S6	4.4	4.19
BH-S7	4.6	3.93
AD-S1	4.6	2.93
AD-S2	5.17	1.41
AD-S3	4.68	1.23
AD-S4	4.69	0.37

The test results indicate a considerable variation in pH value of the groundwater samples. These values were then plotted against the distance from the Rathupaswala glove factory for further analysis (Figure 6).

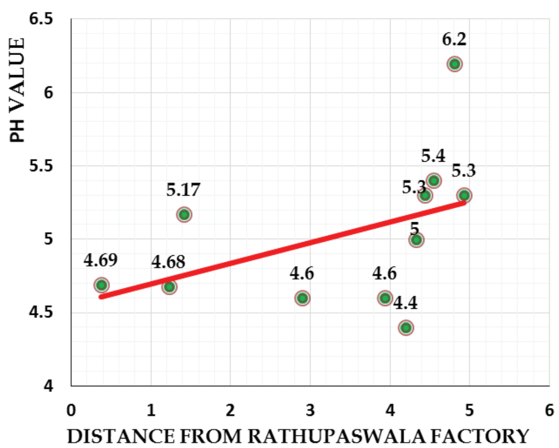

Figure 6 - Variation of pH value against the distance from the Rathupaswala Glove factory

The Scatter plot does not indicate a clear relationship between the distance and pH value. However, a statistical trend line (R^2 = 0.1886) can be fitted (Figure 6).

5.5 Responsibility for the Issue

It is important to understand the public's notion of responsibility when dealing with services to the community. Responses were sought about the parties responsible for the Rathupaswala issue. Respondents were allowed the freedom to name more than one party from 5 suggested entities. Figure 7 illustrates the responses received categorised by the 5 entities.

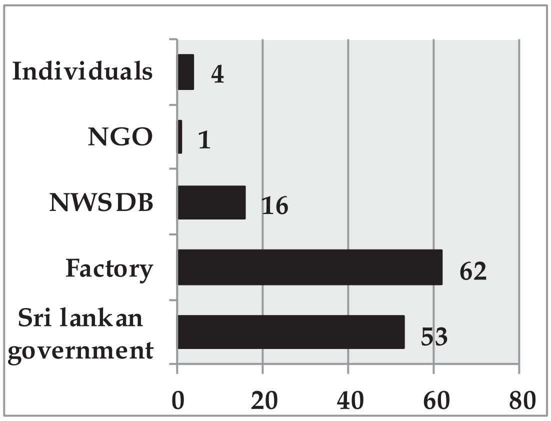

Figure 7 - Responses received about the responsible party for the Rathupaswala issue

Accordingly, 62 respondents of the sample believe that the Latex glove factory should be held responsible for the issue while 53 of them believe that the government is also responsible. Further 16 respondents believe that the National Water Supply and Drainage Board (NWSDB) is responsible for the issue.

6. Discussion

This study attempted to capture a community's perceptions of their drinking and domestic water in the aftermath of a serious social upheaval regarding the quality of groundwater in a neighbouring area. The sample of community was selected within 3 km - 7 km from the place of the incident, the Latex Glove Factory.

The study gives special attention to the parameter 'pH value' as the issue under consideration was based on the low pH values observed in some groundwater samples obtained from the vicinity of the factory's effluent disposal point.

Age and education level are two important factors which strengthen the acceptability of data collected at household interviews. The skewness in the age distribution towards maturity and the high level of education received by all respondents are two important factors supporting the acceptability of the data collected in this study. Further, gender inclusiveness is important in water issues and the balance in gender in this study indicates that the data obtained are not gender biased.

The belief that any impact by the factory effluent to their boreholes is appreciably less in these neighbouring areas. The sample consisted of 15 (14.2%) respondents (Table 3) who believed their groundwater is impacted which resulted in inferring at least 25% of the population would possess the same belief at a 95% confidence level. Interestingly 6 respondents of Group B hold this belief, and most have changed their water source and/or in-house treatment method.

Study of community perceptions is important, either to accept or reject them, before moving to the next stage of taking actions as required. This could be achieved by comparing the perceptions with appropriate real and scientific data. In this sense, the data analyses show that the majority (70%) of the community is aware of the impact of distance on the propagation of groundwater pollution. However, the awareness of the distance between their home location and the factory was noticeably less (only 51%).

Besides, only 13 respondents knew of the exact observation (i.e. low pH) which created the Rathupaswala issue while 58 knew that the observation is related to pH (either high or low). This shows that the majority of the community has not paid much attention to the core reasons of the issue. Out of the 36 respondents who had tested their borehole water, only 1/3rd has tested water for all parameters, while the balance 2/3rds had tested only for pH. This can be considered as a reaction to social dynamics prevailing in the area at the time of the issue.

The results of pH tests of the 14 groundwater samples obtained within a range of 0.3 km to 5.0 km, confirms that none of groundwater samples possessed pH values within the acceptable range (6.5-8.5). Further, considerable variations of pH values (4.4 - 6.2) had been observed in contrast to the more consistent values of pH=6.8 observed in all three pipe borne water samples. The test results of this study confirm the earlier research finding by Wijesekara and Kudahetty [1] to the effect that "generally the groundwater in the Gampaha district is acidic".

The test result for pH value at a distance of 4.8 km from the factory returned a value of 6.2 which is the highest amongst the observed values and the closest to the acceptable range. On the other hand, the pH value of the closest domestic well (370 m from factory) is 4.69 while the recorded lowest value of 4.4 was obtained at a location 4.19 km away from the factory. This indicates random variation of pH values in the area. A further closer look indicates that the low values (pH < 5) were observed up to 4 km and that the variation is localised. The statically fitted trend line is only indicative of the 11 borehole sample results. Further in depth studies inclusive of all contributing factors with large number of samples are required to make a valid conclusion on relationship between the pH value and the distance from Rathupaswala factory, if exists.

An interesting perception of how the community apportioned the responsibility of the issue was revealed. The factory was the most cited entity as the party responsible for the issue, possibly due to the low pH values observed near the factory. However, low pH values were observed from all the samples spread in an area to a distance of 5 km from the factory location. Their random fluctuations clearly indicate the difficulty of holding the factory responsible as the groundwater polluter even if the factory had been functioning improperly with regard to waste disposal. Further, the current observations of pH values are comparable with the low pH values recorded from this area even before the occurrence of controversial issue in 2013 [1].

The majority of respondents possessed theoretical scientific knowledge regarding the two factors (pH and distance), as could be expected from their level of education. However, the numbers who possessed exact knowledge about the issue were much less. In this respect, on the issue of responsibility, fingers pointed at the Government and NWSDB needs to be seriously noted, for they are the entities who should continually educate the public on the quality of the water sources. Had there been a reliable and accessible system for public awareness, the calamity could have been avoided.

7. Conclusion

Backed by the varied low pH values obtained from the tests on water samples, this research concludes that the areas near the questionable latex glove factory at Rathupaswala in the Gampaha District contain acidic groundwater. Further, it can be concluded that the pH variation is independent from the factory effluent for two reasons: first, these low pH observations were made 2 years after the factory was removed, and second, the lowest pH values were observed at water sources far away from the factory than those located nearby. As such, the occurrence of acidity is contributed to natural reasons rather than the factory effluent. This conclusion supports the comparable findings in previous research literature.

An apparent trend of decreasing pH value (i.e. increasing acidity) was observed when moving towards the former Rathupaswala glove factory. This is one of the scientific reasons for the public uproar and reaction of the people at the Rathupaswala issue. However, more water sample test results, both varying spatially and temporally, are required to conclude such a dip in the pH values.

It is concluded that the Rathupaswala issue had not impacted the perceptions of groundwater usage for more than 3/4th (75%) of the community in the study area at a 3 km - 7 km distance from Rathupaswala. Further, it was found that 60% of the community were aware that the distance is inversely proportional to the impact of such an issue. This understanding is the reason for the community to be unafraid of the Rathupaswala issue. However, a minority of the community members, i.e. those who believed that their groundwater source had been impacted by the factory effluent, accepted socioeconomic dynamics and test results of water samples as major reasons for their beliefs.

The majority of the respondents blame the factory for the incident despite having an education at least at secondary level. They are unaware of the fact that the groundwater in the entire area has low pH. The Government, and NWSDB too are held as parties responsible for acidity of groundwater even though it is due to natural reasons. Therefore, this is as an eye-opener for the Government and the NWSDB to be more effective by making an awareness system on groundwater quality which could be easily accessible to the public.

References

1. Wijesekara, R. S., Kudahetty, C., "Preliminary Groundwater Assessment & Water Quality study in Aththanagalu Oya Basin", *National Conference on water, food, security & climate change in Sri Lanka*, Vol. 2, June, 2009, pp. 77-86.

2. Thoradeniya, B., Bulathsinhala, A., "Community perceptions on drinking and domestic water: A pilot study", *Annual Sessions of IESL*, 2015, pp. 263-270.

3. https://www.google.lk/maps/place/Gampaha/@7.1169434,80.0141555,11z/data=!3m1!4b1!4m2!3m1!1s0x3ae2fb79a15f882f:0x5fe45097c70adf03, Visited, 17/12/2014.

4. Doria, M. F., "Factors influencing public perception of drinking water quality", *Water Policy*, Vol. 12, 2010, pp. 10–19.

5. WHO, *Guidelines for drinking-water quality,* 2nd ed., Vol. 2, World Health Organization, Geneva, 1998, 127 p.

6. Abedin, M. D., Anwarul, H. U., Shaw, R., "Community Perception and Adaptation to Safe Drinking Water Scarcity: Salinity, Arsenic, and Drought Risks in Coastal Bangladesh", *Int J Disaster Risk Sci*., Beijing Normal University Press, Vol. 5, 2014, pp. 110–124.

7. Agathe, E., Haghe, J. P., "What kind of water is good enough to drink? The evolution of perceptions about drinking water in Paris from modern to contemporary period" *Water History, Springer, Netherlands*, Vol. 4, No. 03, December, 2012, pp. 231–244.

8. Wedgworth, J. C., Brown, J., Johnson, P., Olson, J. B., Mark, E., Forehand, R., Stauber, C. E., "Associations between Perceptions of Drinking Water Service Delivery and Measured Drinking Water Quality in Rural Alabama", *Int. J. Environmental Research and Public Health*, *MDPI AG,* Vol. 11, No.07, July, 2014, pp. 7376-7392

9. http://www.waterboard.lk/scripts/ASP/Quality_Standards.asp. Visited, 01/12/2014

10. Environment Protection Agency, *Parameters of water quality, interpretation and standards*, Environment Protection Agency, Ireland, 2001, 133 p.

11. Sasikaran, S., Sritharan, K., Balakumar, S., Varasaratnam, V., "Physical, chemical and microbial analysis of bottled drinking water", *Ceylon Medical Journal, Sri Lanka Medical Association*, Vol. 57, No. 3, September, 2012, pp. 111-116.

12. http://www.livestrong.com/article/214475-health-effects-of-ph-on-drinking-water/ Visited, 02/12/2014

13. Gunatilake, S. K., Samaratunga, S. S., Rubasinghe, R.T., "Chronic Kidney Disease (CKD) in Sri Lanka - Current Research Evidence Justification: A Review", *Sabaragamuwa University Journal*, Vol. 13, No 02, December, 2014, pp. 31-58.

14. Young, S. M., Pitawala, A., Ishiga, H., "Factors controlling Fluoride contents of groundwater in north-central and north-western Sri Lanka", *Environmental Earth Sciences*, *Springer,* Vol. 63, No. 6, November, 2010, pp. 1333-1342.

15. Paranagama, A., Jayasuriya, N., Buhuiyan, A.M., "Water quality parameters in relation to chronic kidney disease in Sri Lanka. *International Conference on Sustainable Built Environment*. Kandy, Sri Lanka, December, 2012, pp. 173-183.

16. Botheju, D., Abesinghe, K., "Public Perception towards Chemical Process Industry: Comprehension & Response Planning" *Safety and reliability: methodology and applications*, Nowakowski et al. (Eds.), Taylor and Francis Group, London, 2014, pp. 453-460.

17. Ranmadugala, S. B. H., Kodithuwakku, K. A. W. "An Analysis of Existing Ground Water Management and Policy Matters in Industrial Areas: A Case Study from Rathupaswala", *Annual Research Symposium, E-repository*, University of Colombo, 2015, pp.