



Situational study of the drinking water quality in Quilombola communities in the municipality of São-Luís-Gonzaga, MA, Brazil.

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ABSTRACT

This study's objective was to diagnose the public distribution systems and water quality in the 'Quilombola Communities' of São-Luís-Gonzaga, Maranhão, Brazil, through visual inspections and microbiological analysis; revealing that all 12 analyzed distribution systems lacked water treatment, maintenance, and continuous supply. Microbiological analysis showed 100% of the 35 samples positive for Total Coliforms and 40% for *Escherichia coli*, putting the population at risk of acquiring water-borne and -related diseases; showing that the mere presence of a public water distribution system is no guarantee for good quality drinking water in adequate quantities; confirming the need for a new national public policy.

Key words: Water. Quality. Quantity. Rural Sanitation.

1 INTRODUCTION

1.1 Concept

The word 'Quilombo' originates from the Africans who spoke the Bantu language, and who were forcefully deported as slaves to Brazil (Freitas et al., 2011; Munanga, 2001) and means 'forest warrior camp' (Freitas et al., 2011). The Brazilian usage of the word came about during colonial times when the governing elite gave this name to the communities formed by 'rebellious' slaves that had fled from the farms to the forests (Pinho et al., 2015). 'Decree 4887' of the 20th of November 2003, stipulates how the descendants of these slaves are officially recognized as 'Quilombola Communities' (Brasil, 2003).

1.2 History and Habits

The Quilombola Communities in Brazil were formed by the African slaves that fled from their slave quarters and the forced labor at the plantations of their 'masters' and formed small isolated communities, often in the middle of the forest.

However, this was not the only way communities were formed. History also records Quilombola Communities that were formed after land was donated to them, or were acquired through labor, and even lands that were donated by widows to their most trusted slaves, or through inheritance, appointed to illegitimate sons of slave women with their masters. Furthermore there were the so-called 'black-lands', 'saint-lands', or 'lands-of-the-most-holy', which originally were lands dedicated to saints, that were subsequently occupied by these former slaves and their descendants (Brasil, 2007a; Brasil, 2012; Brasil, 2013).

Today these communities still have a strong family based agricultural system, where each family cultivates their own piece of land. According to government research in 'Chamada Nutricional Quilombola 2006' (Brasil, 2007b) 94% of these communities still depend on their own agriculture, 56% keep farm animals and 32% fish, all mainly used for their own consumption and only a very small part for commercial trade. They are also still very much engaged in religious and cultural folklore which have their roots in the customs of their African ancestors (Freitas et al., 2011; Gomes et al., 2013; Pinho et al., 2015).

1.3 Statistics: Brazil and Maranhão State

According to Fundação Cultural Palmares (2016) there are more than 2,600 communities officially registered as Quilombola Communities in Brazil in 24 of the 26 states of Brazil (exempting only the states of Acre and Roraima and the Federal District). The majority of them are located in the states of Maranhão, Bahia, Pará, Minas Gerais e Pernambuco (mainly located in the north and north-eastern parts of Brazil).

Maranhão is the state with the second largest number of officially recognized Quilombola Communities (the state of Pará has the largest number). 'According to the 'Centro de Cultura Negra do Maranhão' there are 527 Quilombola Communities in Maranhão. These communities are distributed over 134 municipalities' (CPISP, 2016a).

Up to October 2007, only 20 Quilombola Communities in Maranhão had managed to acquire the official titles of their lands. These titles were issued by the state government through the 'Instituto de Terras do Maranhão' (ITERMA). (SEPPIR, 2016)

1.4 Socio-Economic Context

Although slavery was officially banished in Brazil in 1888, the problems of racial segregation and the lack of access to basic rights like healthcare, education, and basic sanitation for the Quilombola Communities were not resolved, the consequences of which are still noticeable today. Comparing the 'Human Development Index' (HDI) of Quilombola Communities with other segments of the Brazilian population, a large inequality becomes apparent, especially when considering access to education, treated water, sewer systems, waste collection, health services, etc.; leaving these communities open to a great social vulnerability (Nery, 2004).

Although in Brazil 83% of the population has access to treated water, on average only 54% of the population of the State of Maranhão has this access and only an alarming 10% is connected to a sewer system; and as these percentages are a lot higher in the larger cities of Maranhão, this means that in the rural communities (like the Quilombola Communities) they hardly have any such access.

Several independent studies have shown that nationwide the large majority of Quilombola Communities do not have running water, depending therefore solely on small wells and streams, thus exposing the population to a large risk of waterborne diseases. As solid waste is not publically collected, they are either burned, buried or just left in the open air (Brasil, 2009; Silva, 2007; Vale, 2012).

Having insufficient access to good quality drinking water, is a main risk factor for causing the transmission of various diseases to the general population; be it through direct contamination of drinking water and/or the contamination of food/crops by human or animal feces (Cholera, Hepatitis A, Polio, Amoebiasis, Giardiasis, etc.) or through the insufficiency of water to provide for basic hygiene, as for washing hands, bathing, preparing food, etc.; all contributing to a much higher risk of diarrheic diseases and causing diseases like trachoma, scabies, etc. (Ashbolt, 2004).

The most common causes for water supply systems to become contaminated are: fecal contamination of surface water or groundwater through the disposal of wastewater directly into rivers without treatment –be it without any treatment or inadequate treatment– a faulty distribution system, broken or contaminated pipes, and lack of maintenance (Ishi & Sadowsky, 2008; Cabral, 2010).

According to the World Health Organization (2016) at least 1.8 billion people in the world consume water contaminated by feces. They estimate that 842,000 people die every year of diarrhea alone, because of a lack of basic sanitation, inadequate supplies of drinking water, and bad hygiene habits.

1.5 Justification

Several studies have indicated that insufficient access to drinking water, especially in the poorer regions like the North and North-East of Brazil, is a major health and social problem. However, most studies that present data about water quality in rural areas have not gathered data from the isolated Quilombola Communities. The need for this present study, therefore, is based on the necessity to create a situational overview of the current availability and quality of drinking water within these Quilombola Communities.

1.6 Objectives

1.6.1 General objectives

The general objective of this study is to diagnose the sanitary situation of the Quilombola Communities located in the municipality of São-Luís-Gonzaga, in the

state of Maranhão, Brazil, focusing on the water supply systems and the quality of the drinking water consumed by the general population in these communities.

1.6.2 Specific objectives

- To diagnose the current situation of the water supply system of the communities in question;
- And verify the parameters of the microbiological quality of the drinking water consumed by their general population in relation to the norms, concerning drinking water quality, established in 'Decree 2914/2011' of the Brazilian Ministry of Health (Brasil, 2011).

2 METHODOLOGY

To realize a study of the socio-economic conditions and of sanitation related to the drinking water supply in Quilombola Communities, a revision of published scientific articles was done through verifying the databases of the following research portals: BIREME, PUBMED, SCIELO.

The keywords used for searching these databases (translated from Portuguese) were: 'Quilombolas', 'water', 'sanitation', 'health', 'vulnerability'.

As sources for official information, documents, forms, and official publications of government organizations and of government information-gathering systems, databases of organizations such as FUNASA, IBGE, SNIS, and SIAB, were used.

The method used for the categorization of the water distribution system, was the filling out of a standard form after a visual inspection; and for the analysis of the drinking water, the collection of samples from the wells used by the general population, subsequently microbiologically analyzed in a specialized laboratory, using the technique of chromogenic substrate; all performed by qualified government employees.

3 BIBLIOGRAPHICAL REVISION

3.1 History of the Quilombos in the State of Maranhão, Brazil

Maranhão is considered a 'latecomer' in relation to slave culture, by the fact that as late as 1750 the number of slaves in the state was almost irrelevant. Only in the late eighteenth century agricultural developments, responding to the European demands for rice and cotton, led to a significant increase in the number of slaves that needed to work on the plantations (Assunção, 2010).

It was between 1755 and 1758 that the 'Companhia Geral do Comércio do Grão-Pará e Maranhão', who at that time had a monopoly on the local slave trade, brought over 12,000 Africans, and subsequently, little before the independence of Brazil (that happened during 1822-1825) Maranhão developed into having the largest percentage of slaves in Brazil (78,000 slaves comprising 55% of the population). But due to the economic crisis of 1817 and the wars for the independence between 1822 and 1823, and the 'Balaiada revolt' between 1838 and 1841, that took place directly in the cotton producing areas of Maranhão, the cotton trade greatly diminished and this consequently considerably reduced the slave trade well before 1850 (Assunção, 2010).

Subsequently it became very common in Maranhão to find Quilombos in the forest areas in the vicinity of the farms, formed by fugitive slaves. This especially happened where there were high concentrations of farms and slaves, like around the villages of 'Alcântara', 'Viana', 'Vitória do Mearim', 'Itapecuru-Mirim', 'Rosário' and 'Manga do Iguará' (CPISP, 2016b).

On several occasions farmers and local authorities joined forces to try to stop the advance of the Quilombos, but the area where they could hide was so vast that the army had not nearly enough manpower to cover the whole state, so it became like looking for a needle in a haystack (Assunção, 2010).

However, only few Quilombola Communities actually lived completely isolated; as most communities sought some kind of interaction with society. They interacted with those still enslaved and even worked as hired hands for local farmers, who in turn helped them hide from police raids. This particular relationship helped them acquire material goods and also the necessary information about troop movements (CPISP, 2016b).

4 RESULTS

4.1 Demography

According to IBGE (2016) the municipality of São-Luís-Gonzaga:

- Is located in the micro-region of 'Médio Mearim' and meso-region of 'Centro Maranhense';
- Has a population of 20.156 inhabitants, according to the last demographic census (2010);
- Has a territorial area of 909 km² (351 square miles);
- Has a biome with both characteristics of savanna and tropical rainforest;
- Its inhabitants are called 'Gonzaguenses';
- Is neighbor to the municipalities of 'Trizidela do Vale', 'Bacabal', and 'Bernardo do Mearim';
- Is located 22 km (14 miles) south east of Bacabal, the largest city in the area;
- Lies on average 17m (56 feet) above sea level;
- Its geographical coordinates are: Latitude: 4° 22' 51" South; Longitude: 44° 40' 14" West.



Figure 1 – Location of the municipality of São-Luís-Gonzaga

The municipality of São-Luís-Gonzaga has 20 registered Quilombola Communities, certified by the 'Fundação Palmares'. This present diagnostic study of the simplified water supply systems as well as the microbiological analysis of the water quality was performed in the following 12 of these 20 communities: 'Pedrinhas', 'Potozinho', 'Mata Burro', 'Morada Nova dos Deusdeth', 'Potó Velho', 'Promissão', 'Vale Verde', 'Santa Rita', 'Santarém', 'Olho d'Água dos Grilos', 'Monte Alegre', and 'Coheb'. In the following four communities there simply is no water supply system or it has been deactivated through lack of maintenance: 'São Pedro', 'Boa Vista dos Freitas', 'Fazenda Conceição', and 'Centro Velho'; meaning that in these communities the population only uses private open wells.

The principal income source of families in the analyzed communities comes from family-size agriculture, government family support and government supplied pensions. Women are mainly occupied by taking care of the home and the children and may help earn some extra as 'coconut breakers'.



Figure 2 – Women breaking coconuts in front of a typical 'mud house'

Most houses are made from some wood, twigs and clay and are covered with interwoven palm tree branches. Families normally raise animals and pets, like: pigs, cows, chicken, dogs and cats; for food as well as for security and/or entertainment. Animals are not fenced in however, so they walk around and defecate close to the homes, water supply systems, washing areas, food preparation areas and water reserves. Solid waste is mainly burned or buried, as there is no public collection system. In none of the communities houses had internal bathrooms; they mainly use shallow holes for their toilets and sanitary objects are left on the surface in the bushes near their homes.

According to the World Health Organization (2013) 'one billion people (15% of the world population) still practice open defecation.' (I.e. when human feces are disposed of in the fields, forests, bushes, open bodies of water, beaches, and other

open spaces). 'The majority (71%) of those without sanitation live in rural areas and 90% of all open defecation takes place in rural areas'.



Figures 3 & 4 – Animals walking freely in the vicinity of houses and water reserves

4.2 Diagnostic of the current situation of the water supply systems of the studied communities

A sanitary inspection was done on the water supply systems; a photographic record was made and water samples were taken for microbiological analysis.

The inspected systems are basically comprised of one to three deep tubular wells, surrounded by a geo-mechanic tube, a fiber-glass water reservoir suspended on a concrete structure, and most of the time a domiciliary tubular distribution network. The pump is driven by an electromotor and sheltered in a pump house. The pump is used to pump water from the well to the elevated reservoir.

In the communities that do not have this simplified water supply system or where the system is out of order, the population uses water coming from the shallow open wells they themselves have dug. As these communities do not even have or use such a simple water supply system or any tubular distribution system as mentioned above, there was also no analysis done on the quality of the water that comes from these wells and consequently the percentages of the presented data in this study from the microbiological analysis do not take into account the water quality of these shallow open wells, but only refer to the systems that use tubular wells.



Figures 5 & 6 – Left: Simplified Water Distribution System; Right: A shallow open well dug by locals

Table 1 – Type of Water Source (in all 16 communities)

Where does the Water used by the Community come from?	% of Quilombola Communities
Surface Water	0%
Subterranean Water	100%
Surface + Subterranean Water	0%

100% of the communities in the researched group use subterranean water.

Table 2 – Type of Well (in all 16 communities)

What Type of Well do they use to Withdraw the Water?	% of Quilombola Communities
Tube Well	75%
Open Well	25%
Tube + Open Well	0%

To withdraw this subterranean water they either use deep Tube Wells or shallow Open Wells. The Tube Wells were installed by the local government/municipalities, whereas the Open Wells were dug by the local population.

Table 3 – Type of Treatment (in all 16 communities)

What Type Of treatment does the Water receive?	% of Quilombola Communities
Conventional (Full Treatment)	0%
Only Filtration	0%
Only Disinfection	0%
Filtration + Disinfection	0%
No Treatment at all	100%

Not one of the water supply systems diagnosed in the study had any type of treatment for the water distributed to the population.

Table 4 – Distribution Network (in the 12 communities with Tubular Wells)

Is there a Distribution Network between the Tubular Well and the Houses?	% of Quilombola Communities
Yes	83%
No	17%

Although many of the Simplified Water Supply Systems in the communities have a Distribution Network between the well and the houses, most of them are relatively old, badly maintained, in many places pipes are above ground, and leaks are stopped with strips of rubber, as no corrective maintenance is performed by the local government (the responsible municipalities). The Quilombola Communities called 'Vale Verde' and 'Monte Cristo' have no distribution network at all.



Figures 7 & 8 – Examples of pipes above ground and 'repaired' with rubber strips



Figure 9 – A leak at the discharge outlet of the well, fixed with strips of rubber. Note as well, that at this well there is both an area to fill up buckets for the population to take water to their homes and at the same time sinks to wash dirty laundry.

Table 5 – Uninterrupted Supply (in the 12 communities with Tubular Wells)

Does the System Provide a Continuous Supply of Water?	% of Quilombola Communities
Yes	0%
No	100%

Table 6 – Microbiological diagnostic of the quality of the drinking water consumed by the Quilombola Communities in the 12 communities with Tubular Wells that participated in this study.

Name of the Quilombola Community	Nr of samples	Positive for Total Coliforms	% with Total Coliforms	Positive for <i>Escherichia coli</i>	% with <i>Escherichia coli</i>
Morada Nova	3	3	100%	3	100%
Potozinho	2	2	100%	0	0%
Pedrinhas	1	1	100%	0	0%
Potó Velho	2	2	100%	2	100%
Monte Alegre	3	3	100%	3	100%
Olho d'Água dos Grilos	2	2	100%	0	0%
Santarém	4	4	100%	0	0%
Santa Rita	3	3	100%	0	0%
Mata Burro	3	3	100%	1	33%
Promissão	3	3	100%	0	0%
Coheb	4	4	100%	2	50%
Vale Verde	5	5	100%	3	60%
TOTAL	35	35	100%	14	40%

5 DISCUSSION

All the 16 communities in this study used subterranean water, either from open wells or tube wells. The open wells ('Cacimbas') are shallow wells, up to 20m deep (66 feet), with a large diameters of 1m (3 feet) or more, dug manually, filled with ground water, with most of the time a water table close to ground level. Whereas the tube wells encountered in these rural areas are machine perforated wells, drilled by geologic engineers, with a diameter generally varying between 10cm and 15cm (4 inch and 6 inch) and going to depths of up to 200m (656 feet), which capture water from much purer layers of confined subterranean water. The deeper and more confined the layer of water is, the less chance of contamination, as water ends up being filtered through more soil, sometimes at high pressures, so that a large part of the microorganisms are removed (FUNASA, 2015). A shallow open well does not only have less filtration, making contamination through nearby buried waste, industrial residues, agricultural toxins, human and animal feces from the surface or from septic pits, etc. more likely; it can also easily be contaminated by objects, residues, or even animals that fall into the well; making it still necessary (like when using surface water) to treat the water to make it safe for human consumption or other usage. Whereas water from deep wells is more likely to get contaminated only once it is above soil, through contaminated pipes, reservoirs, etc. (Tucci et al., 2003a; Tucci et al., 2003b).

In the communities that were part of this study several of these risk factors were plainly observed, like the raising of many types of animals close to the wells, solid waste scattered on the soil, the total lack of indoor bathrooms and a sewer system. A situation that is very similar to Quilombola Communities observed in other studies (Pinho et al., 2015; Amorim et al., 2013).

Like in most rural areas, the water that is being distributed to the population in the studied communities receives no type of treatment. 'Decree 2914/2011' of the Brazilian Ministry of Health, which deals with drinking water quality control and sur-

veillance and its quality parameters, establishes in 'article 24' that all public water supply systems and any of its alternative solutions need to have a system of disinfection, independent on its source (be it from subterranean wells or surface water). (Brasil, 2011).

Many factors contribute to the lack of appropriate treatment of drinking water in rural communities, like: public authorities who do not perform their duties, lack of awareness of the current applicable laws, legislations and technologies, precarious supply and distribution systems because of poor or outdated designs or lack of maintenance, the lack of qualified personnel, the cost of materials and disinfection products, etc. (FUNASA, 2014).

In nine out of the twelve communities with tubular wells contamination by *Escherichia coli* was found in the water samples, which is a type of bacteria resident in human and warm blooded animal intestines and considered the most specific indicator for recent fecal contamination and the possible presence of pathogenic organisms. Any population that consumes contaminated water like this is at risk of acquiring water-borne diseases (Brasil, 2007a; Brasil, 2006).

In all supply systems with tubular wells analyzed in this study, there was no continuous supply of water, causing lack of pressure with possible backflow of contaminated water and air entering the system, creating risks of contamination of the whole system. As the supply is not constant or does not come in sufficient quantities, water also tends to be stocked in and around the homes, where often inappropriate and open containers are used, creating more disease proliferating conditions. For example, stagnant open water can easily become a habitat for disease spreading mosquitos like the *Aedes aegypti*, transmitter of diseases like Dengue Fever, Zika Virus, etc. Insufficient water supplies to the homes may also easily lead to insufficient personal hygiene, which in turn can lead to a variety of diseases.



Figures 10 & 11 – Water inadequately stocked in the homes

It is therefore important to emphasize, that not only lack of quality, but also lack of continuity and quantity are determining disease proliferating factors for humans (Brasil, 2006).

This establishes that the lack of access to basic sanitation services, like the supply of good quality drinking water, a sewer system, public garbage collection, etc. are part of a major problem faced by the large majority of Quilombola Communities. (Pinho et al., 2015; Guerrero, 2010; Amorim et al., 2013, Silva, 2007; Sousa et al.,

2015). There is therefore an imminent need for a more effective implementation of public policies, so that the general population has their right to basic sanitation and health properly met.

6 CONCLUSION

This present study clearly reveals, that the mere presence of a public water distribution system is no guarantee at all that the actual need of the population to have access to good quality drinking water in adequate quantity is met. There are many factors that cause this problem, such as a lack of system maintenance, poor design, improper usage, the total absence of treatment of the distributed water, etc.

This confirms the need for an urgent new public policy on a national level that establishes:

- a. A viable development of complete and adequate sustainable distribution systems of water, properly treated for human consumption, in rural areas and
- b. The obligation of the local government to establish municipal sanitation and water-distribution policies which guarantee the proper public administration of these systems in cooperation with the local community.

7 REFERENCES

Amorim, M. M., Tomazi, L., Silva, R. A. A. d., Gestinari, R. d. S. & Figueiredo, T. B. (2013) Avaliação das condições habitacionais e de saúde da comunidade quilombola boqueirão, Bahia, Brasil. *Biosci. J., Uberlândia*, v. 29, n. 4, p. 1049-1057, July/Aug. 2013.

Ashbolt, N. J. (2004) Microbial contamination of drinking water and disease outcomes in developing regions. *Toxicol.*, v. 98, p. 229–238, 2004.

Assunção, M. R. (2010) *A memória do tempo de cativo no Maranhão*. Available from: <http://www.historia.uff.br/tempo/site/wp-content/uploads/2010/12/v15n29a04.pdf> [Accessed 17th December 2016].

Brasil (2003) *Constituição da República Federativa do Brasil (1988)*. Decreto nº. 4887/03. Brasília, Senado, 2003.

Brasil (2006) *Vigilância e controle da qualidade da água para consumo humano*. Ministério da Saúde, Secretaria de Vigilância em Saúde. Brasília: Ministério de Saúde, 2006.

Brasil (2007a) *Chamada Nutricional Quilombola 2006*. Ministério do Desenvolvimento Social e Combate a Fome, Secretaria de Avaliação e Gestão da Informação Departamento de Avaliação e Monitoramento, Esplanada dos Ministérios, Bloco A, Sala 405 - 70054-900-Brasília-DF, 2007.

Brasil (2007b) *Educação Quilombola salto para o futuro*. Ministério da Educação. Glória Moura, 2007.

Brasil (2009) *Comunidades Quilombolas Brasileiras - Regularização Fundiária e Políticas Públicas*. Secretaria Especial de Políticas de Promoção da Igualdade Racial. Programa Brasil Quilombola. Subsecretaria de Políticas para Comunidades Tradicionais. Brasília: Ministério da Saúde, 159p, 2009.

Brasil (2011) Portaria 2.914, de 12.12.2011. Dispõe sobre os procedimentos de controle e de vigilância da qualidade da água para consumo humano e seu padrão de potabilidade. Brasília: Ministério da Saúde. *Diário Oficial*, 14.12.2011, Seção I.

Brasil (2012) *Diagnóstico de ações realizadas*. Secretaria Especial de Políticas de Promoção da Igualdade Racial. Programa Brasil Quilombola. Subsecretaria de Políticas para Comunidades Tradicionais. Brasília: Ministério da Saúde, 2012.

Brasil (2013) *Guia de Políticas Públicas para comunidades quilombolas*. Secretaria Especial de Políticas de Promoção da Igualdade Racial. Programa Brasil Quilombola. Subsecretaria de Políticas para Comunidades Tradicionais. Brasília: Ministério da Saúde, 2013.

Cabral, J. P. S. (2010) Water Microbiology: Bacterial Pathogens and Water. *Int. J. Environ. Res. Public Health.*, 7, p. 3657-3703, 2010.

Comissão Pró-Índio De São Paulo, CPISP (2016a) *Comunidades Quilombolas do Estado do Maranhão*. Available from: http://www.cpisp.org.br/comunidades/html/i_brasil_ma.html [Accessed 19th December 2016].

Comissão Pró-Índio De São Paulo, CPISP (2016b) *Escravidão e Formação de Quilombos no Maranhão*. Available from: http://www.cpisp.org.br/comunidades/html/brasil/ma/ma_escravidao.html [Accessed 19th December 2016].

Freitas, D. A., Caballero, A. D., Marques, A. S., Hernández, C. I. V. & Antunes, S. L. N. O. (2011) Saúde e comunidades quilombolas: uma revisão da literatura. *Rev. CEFAC*, 13(5): 937-943, 2011.

Fundação Nacional de Saúde, FUNASA (2014) *Manual de cloração de Água em pequenas comunidades utilizando o clorador simplificado desenvolvido pela FUNASA*. Brasília: 2014.

Fundação Nacional de Saúde, FUNASA (2015) *Manual de Saneamento*. 4ª ed. Brasília: Ministério da Saúde, Departamento de Engenharia de Saúde Pública, 2015.

Fundação Cultural Palmares (2016) *Comunidades Remanescentes de Quilombolas (CRQs)*. (Dados atualizados até a Portaria nº104 de 20/05/2016) Available from: http://www.palmares.gov.br/?page_id=37551 [Accessed 12th December 2016].

Gomes, O. K., Reis, A. E., Guimarães, C. D. M. & Cherchiglia, L. M. (2013) Utilização de serviços de saúde por população quilombola do Sudoeste da Bahia, Brasil. *Cad. Saúde Pública*, 29(9): p. 1829-42, 2013.

Guerrero, A. F. H. (2010) *Situação Nutricional de Populações Remanescentes de Quilombos do Município de Santarém, Pará – Brasil*. Rio de Janeiro: s.n., 2010.

Instituto Brasileiro de Geografia e Estatística, IBGE (2016) *São Luís Gonzaga do Maranhão*. Available from: <http://www.cidades.ibge.gov.br/xtras/perfil.php?lang=&codmun=211140&search=maranhao|sao-luis-gonzaga-do-maranhao> [Accessed 17th December 2016].

Ishi, S. & Sadowsky, M. J. (2008) *Escherichia coli* in the environment: Implications for water quality and human health. *Microbes Environ.*, v. 23, n. 2, p. 101-108, 2008.

Munanga, K. (2001) Origem e histórico do quilombo em África. In: *Moura, C. Os quilombos na dinâmica social do Brasil*. Maceió: EDUFAL, p. 21-31, 2001.

Nery, T. C. S. (2004) Saneamento: ação de inclusão social. *Estudos Avançados*, v. 18, n. 50, p. 313-321, São Paulo, 2004.

Pinho, L., Dias, R. L., Cruz, L. M. A. et al. (2015) *Condições de saúde de comunidade quilombola no norte de Minas Gerais*, 2015.

Secretaria De Políticas De Promoção Da Igualdade Racial Da Presidência Da República, SEPPIR (2016) *Programa Brasil Quilombola*. Available from: <http://monitoramento.seppir.gov.br/paineis/pbq/index.vm?eixo=1> [Accessed 12th December 2016].

Silva, J. A. N. d. (2007) Condições Sanitárias e de Saúde em Caiana dos Crioulos, uma Comunidade Quilombola do Estado da Paraíba. *Saúde Soc.*, v.16, n.2, p.111-124, São Paulo, 2007.

Sousa, L. S & Souza, R. R. (2015) Sistema de abastecimento de água na comunidade quilombola Terra Amarela em Colares-PA: necessidades e desafios. *Boletim Amazônico de Geografia, Belém*, v. 02, n 4, 61-73, 2015.

Tucci, C. E. M. & Cabral, J. J. d. S. P. (2003a) *Prospecção Tecnológica Recursos Hídricos Qualidade da Água Subterrânea, Documento Final*. Available from: http://www.cgee.org.br/arquivos/a2b_agua_sub.pdf [Accessed 26th January 2017].

Tucci, C. E. M. & Cabral, J. J. d. S. P. (2003b) *Qualidade da água subterrânea*. Available from: http://www.cgee.org.br/arquivos/a3b_agua_sub.pdf [Accessed 18th of February 2009].

VALE (2012) *Levantamento das condições de Saúde das localidades de Santa Rosa dos Pretos e Monge Belo (MA)*. Companhia Vale do Rio Doce, 2012.

World Health Organization, WHO (2013) *Progress on sanitation and drinking water: Fast Facts. 2013 Joint Monitoring Programme Report*. Available from: http://www.who.int/water_sanitation_health/monitoring/coverage/jmp_fast_facts/en/ [Accessed 17th December 2016].

World Health Organization, WHO (2016) *Factsheets*. Available from: <http://www.who.int/mediacentre/factsheets/fs391/en/> [Accessed 12th December 2016].