AMBIENTE & SOCIEDADE
25 anos años years

SciELO

Conditions of use and levels of household access to water in rural communities in the Amazon

Maria Cecilia Rosinski Lima Gomes [I, II]
Leonardo Capeleto de Andrade [I]
Ana Claudeise Silva do Nascimento [I, III]
João Paulo Borges Pedro [I]
Cesar Rossas Mota Filho [II]

Abstract: Access to water is a human right and a UN Sustainable Development Goal (SDG). However, in riverine communities in northern Brazil, there is a prominent lack of water supply and other public services. This study aimed to analyze the conditions of household water use in riverine communities in the Central Amazon and classify their level of access to clean water according to those established by the World Health Organization (WHO). Secondary data from 3,285 households in floodable and non-floodable areas in the Mamirauá and Amanã Sustainable Development Reserves were evaluated. The analysis was performed using descriptive statistics and simple correspondence analysis. It was found that 71% of the population has basic access to water, with rainwater harvesting and chlorine point-of-use treatment. To improve access to water, investments are needed for the improvement of rainwater harvesting systems and the use of complementary water sources, be it collectively or individually (per household).

Keywords: Water access, household water treatment, rural population, Amazon, floodplain.

[I] *Instituto de Desenvolvimento Sustentável Mamirauá, Tefé, AM, Brasil.*

[II] *Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brasil.*

[III] *Universidade Federal do Sul e Sudeste do Pará, Marabá, PA, Brasil.*

São Paulo. Vol. 25, 2022

Original Article

DOI: http://dx.doi.org/10.1590/1809-4422asoc20210178r12vu2022L4OA

Introduction

The Amazon biome is a cradle of biodiversity, carbon sequestration, and generation of ecosystem services such as water security, renewable energy generation, genetic diversity for the production of medicines and income security, and cultural identity for the local population (STRAND et al., 2018; JOLY et al., 2019). Extending over 21 million hectares, there are wetlands of international importance, such as floodplains and igapo forests (THE RAMSAR CONVENTION, 2021). However, the development model that has been growing in popularity in the Brazilian Amazon is associated with deforestation, loss of biodiversity, and neglected tropical diseases (NOBRE et al., 2016; CODEÇO et al., 2021). The conservation of this region is known to depend on its sustainable use and the participation of local, indigenous, and riverine populations (FRANCO et al., 2021; CAMPOS-SILVA et al., 2018).

Most of the Amazon rainforest is in northern Brazil, a region where only 60% of households are connected to a water supply system (IBGE, 2016). Moreover, the absolute majority of these are in cities, especially capitals. In rural areas, approximately 4.4 million residents use alternative means of water supply, such as water-supply wells, springs, rivers and lakes, or rainwater harvesting (IBGE, 2016). Poor supply of water is a violation of a fundamental human right (UNITED NATIONS, 2010). The negative impact on human health and well-being is one of the consequences of these conditions, in addition to the 500,000 deaths worldwide from diarrheal diseases associated with poor drinking water quality (PRÜSS-USTÜN et al., 2014).

The lack of access to water, sanitation, and hygiene (WASH) affects mostly women as they are the ones who are often responsible for collecting and treating water in the household – a prolonged, exhausting, and unpaid job (ANDERSON et al., 2021; DICKIN et al., 2021). Due to the lack of sanitation, psychosocial impacts, such as physical, financial, and social stress and perception of inequity, can be observed as well. For women, perceptions of fear, feelings of responsibility, and time spent in activities related to the search for water were also reported (BISUNG; ELLIOTT., 2017). The act of carrying the water (in the arms or on the shoulders or head) is another relevant effect of poor access to water since it is one of the main causes of musculoskeletal pain and diseases where this practice occurs (GEERE et al., 2018).

Household water treatment (HWT) or point-of-use (POU) treatment may be alternatives or complementary to the water supply system. They can be any type of device or method used to treat water at home or at the point of use (WHO, 2017a), being generally simple, low cost, easy to maintain, and independent from the supply system (POOI; NG, 2018). These solutions, which should be used in conjunction with safe water storage, aim to empower people without access to water and, consequently, improve health and reduce diarrheal diseases in developing countries (SOBSEY, et al., 2008).

The World Health Organization (WHO) recommends that HWT should be carried out in places where there is no water supply service available, there is basic access to water, or the supply system is not quality-assured (WHO, 2017a). Based on the needs of the most vulnerable population (lactating women who perform physical activity at moderately high temperatures), the amount of water available per person per day, for drinking and cooking, should be at least 5.3 L (HOWARD et al., 2020). Several HWT devices have been developed for use in rural areas (BROWN et al., 2009; CLASEN, et al., 2009; LEE, 2011; OYANEDEL-CRAVER and SMITH, 2008; RAM et al., 2007; SIWILA and BRINK, 2018; SOBSEY et al., 2003)

Brazilian national data on access to water include the percentage of the water supply system coverage and, where there is no system, water collection sources (IBGE, 2016). Nevertheless, these data fail to include details on typical situations in rural areas, such as the existence of multiple water sources (ELLIOTT et al., 2019; KELLY et al., 2018); and the use of HWT (GOMES et al., 2012).

A global commitment to provide access to clean water was made in the UN Sustainable Development Goal (SDG) 6. Compliance with the SDGs is assessed on a global scale by the United Nations Children's Fund (UNICEF). The access to clean water was divided into five levels (safely managed, basic, limited, unimproved, and surface water) which represent the progress of improvement made toward universal access to water in terms of quality, quantity, and accessibility. This methodology uses national-level data, which are not always available, separated into urban and rural to classify and compare the situation of these different populations over time (WHO, 2017b).

The levels of access to clean water, assessed from local data from riverine communities in the Amazon, may help to understand regional specificities and, therefore, contribute to the assessment and planning of access to water.

Thus, this article aimed to evaluate the conditions of domestic use and classify the levels of access to water in rural communities in Central Amazon.

Method

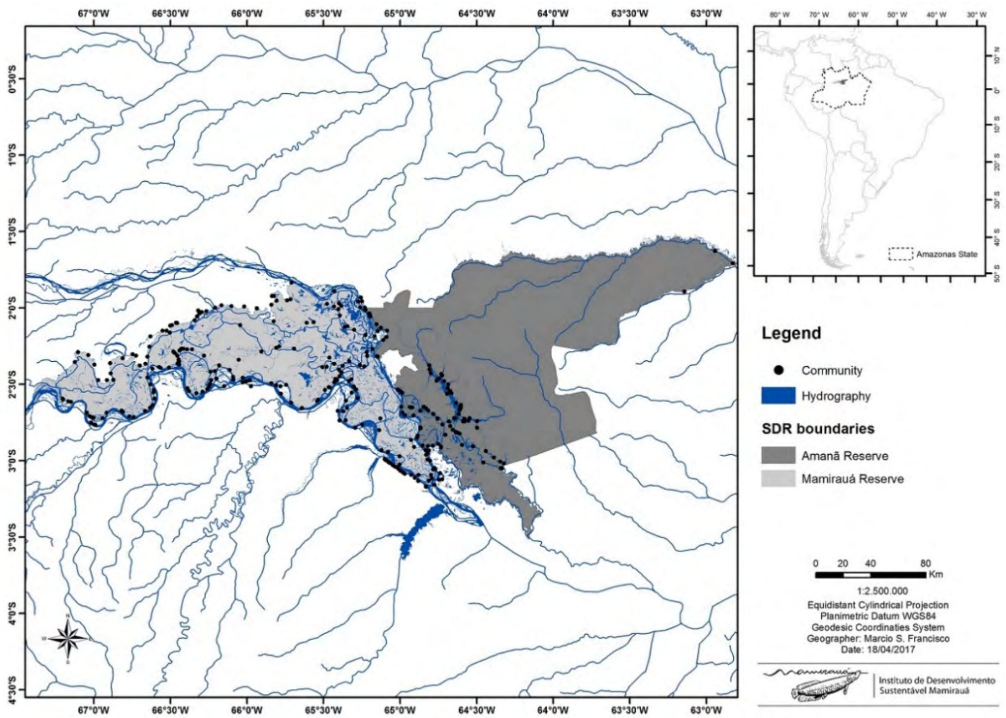
This quantitative research was carried out using descriptive analysis of secondary data. The classification of the level of access to water (WHO, 2017) and analysis of the conditions of household use were performed using the IDSM (Mamirauá Institute for Sustainable Development) demographic and economic monitoring database (SIMDE, 2018). Created in 1993, this database aims to monitor changes in the living conditions of riverine peoples that have been affected by the creation of areas protected by law, for nature conservation, in their territories (MOURA, et al., 2016; PERALTA and LIMA, 2013).

Study area

The data refer to the Mamirauá and Amanã Sustainable Development Reserves (SDR) (Figure 1), situated in the Brazilian state of Amazonas, in Central Amazon. With an area of approximately 30,000 km^2, there are 16,212 residents living in 330 communities in the region.

The study area's mean temperature from 1961 to 2020 is 26°C (22-32°C) and humidity, 87%. The average annual rainfall is 2,475 mm – with higher monthly averages between March and May (280 mm/month) and lower (122 mm/month) between August and September (INMET, 2021).

Figure 1. Location of study area and communities



Source: SIMDE (2018)

Most of the population in the study area lives along the main rivers, in floodplain (várzea), upland (terra firme), or paleovárzea areas. The floodplain is flooded annually in the rainy season and represents 14% of the Amazon basin (MELACK and HESS, 2011). Paleovárzea is considered a transition environment, and upland is a non-floodable forest land. This environment variation affects the lives of the residents of this region both socially and economically (MOURA, 2007).

Database

Data regarding access to water updated in 2018 and 2019 were analyzed (SIMDE, 2018). Demographic information was collected through interviews with structured questionnaires. These were administered by multidisciplinary teams to all the 3,285 households in the 330 communities included in this study. In a sample of 30% of each community, a 12-month retrospective recall method was used to collect socioeconomic data. The survey respondents were the heads of households and the leaders of the communities

(MOURA, et al., 2016; PERALTA and LIMA, 2013).

Descriptive analysis

The database was organized, and continuous variables were categorized (income, distance to the urban center, volume of the water tank, number of residents, and number of rooms in the household). The water storage capacity was classified into ranges based on the per capita water consumption values established by the World Health Organization for different access situations (HOWARD et al., 2020). The volume ranges were as follows: less than or equal to 20 liters; from 20 to 50 liters; from 50 to 100 liters; and 100 liters or more.

The variables used to assess the conditions of domestic use of water were: the existence of a collective water supply distribution system, which includes the infrastructure and equipment used from the collection to the distribution of drinking water (BRASIL, 2021); access to groundwater; harvesting of rainwater in the household; water storage capacity per capita; total water storage capacity; drinking water storage containers; household water treatment practices.

The descriptive variables of the communities were: shorter distance to the nearest urban center (in flood season); differences in the routes taken to the urban center during the flood and dry seasons; number of households in the community; existence of a power generator; and municipality which provides basic public services to the community (municipalities in the region: Alvarães, Uarini, Jutaí, Juruá, Maraã, Fonte Boa, Japurá, Coari, and Tonantins).

The socioeconomic variables were: per capita income range; reading ability of the head of the household and spouse; number of residents; and number of rooms in the household.

The environmental condition variable depended on the location of the community: floodplain (floodable); paleovárzea (partially floodable); or upland (non-floodable).

The variable "distance from the community to the nearest urban center" was calculated from the watercourses in the region with the QGIS 3.10 software, using the Network Analysis tool to find the shortest path (point to layer). For each community, two routes were considered in the path network, one in the dry season and another in the flood season (a few months a year), when it is possible to use shortcuts (i.e. floodplain channels known as "canos" and "furos") in the flooded areas (JUNK et al., 2012).

Levels of access to water

The level of access to water in each household was classified according to the criteria established by the World Health Organization (WHO, 2017b).

• Safely managed: drinking water from an improved (protected) source distributed to the household, available when needed and free from fecal and chemical contamination. Regional cases: supply system with quality control and surveillance, as well as regular source and distribution system of a) disinfected groundwater or b) surface water which has been at the very least filtered and disinfected.

• Basic: drinking water from an improved (protected) source provided collection time does not exceed 30 minutes a roundtrip, including queuing. Regional cases: treated surface water supply and distribution system; well water supply and distribution system; household rainwater harvesting system.

• Limited: drinking water from an improved (protected) source where collection time exceeds 30 minutes for a roundtrip, including queuing. Regional cases: water from an improved source, without a distribution system and with collection time greater than 30 minutes.

• Unimproved: drinking water from an unprotected dug well or unprotected spring. Regional cases: water from unprotected sources, such as a river, channel, or lake, which has not been filtered or disinfected.

• No service: drinking water directly from a river, dam, lake, canal, or irrigation channel. Regional cases: non-existent or non-operational water supply system, no rainwater harvesting, and no access to groundwater.

The levels of access were categorized based on the information from the IDSM database on the existence or non-existence of a supply system and the household water source. In the case of supply systems with water sourced from rivers or lakes, the level was considered basic when there was at least one filtration and disinfection step, as established by the Brazilian Ministry of Health in the Portaria No. 888, regarding the quality of surface water sources for human consumption (BRASIL, 2021)

Households with rainwater harvesting were considered to have basic access to water because, according to the WHO (WHO, 2017b), this is a source that may provide safe water due to the nature of its design or construction.

Statistical analysis

Simple correspondence analysis (SCA) was used to assess the association between each household's level of access to water and variables related to socioeconomic, environmental, and use conditions. Categorical data were analyzed using SCA, to estimate parameters by value decomposition (FITHIAN and JOSSE, 2017, and chi-square statistics (MINGOTI, 2005). Associations were considered significant at a 95% confidence level. The Statistica10 software was used to analyze the data.

Ethical aspects

This study was approved by the Research Ethics Committee of the Mamirauá Institute for Sustainable Development (CEP-IDSM) under CAAE (Certificate of Presentation for Ethical Consideration) No. 42236920.7.0000.8117.

Results

In the Mamirauá and Amanã SDR, 85% of the riverine communities (12,000 residents) do not have a water supply system (Table 1).

Table 1. Existence and status of water supply systems in riverine communities in the middle Solimões River region, Amazonas, Brazil (2018)

Water supply system	Communities		Residents	
	N	%	N	%
Operational	38	12	3,119	19
Non-operational	11	3	1,044	7
Non-existent	281	85	12,049	74
Total	330	100	16,212	100

Source: Prepared by the authors.

Rainwater is harvested in 81% of households (Table 2). In those places where there is no groundwater or rainwater harvesting (10% of the total), the population has access only to surface water from rivers and lakes.

There are water tanks in most of the households assessed (73%). These may be made of medium-density polyethylene or other types of plastic (Figure 2, A, B, C). The total storage capacity of the tanks is 500 L or less in 46% of households and, in 17% of the cases, the capacity ranges from 501 to 1,000 L. The mean per capita storage volume capacity is 157±190 L; however, this per capita capacity is greater than 100 L in only 35% of households.

Figure 2. Household water storage tanks (A, B, C); drinking water storage containers (D, E, F); household water treatment methods (G, H, I)

Source: Prepared by the authors.

Water for direct consumption (drinking water) is stored separately from the rest of the water used for domestic activities. The most used containers to store drinking water are buckets (31%) and post-consumer PET bottles (30%) – usually from soft drinks (Figure 2, D, E, F).

Table 2. Conditions of household water use in rural riverine areas of the Middle Solimões, Amazonas (2018)

Conditions	Households		Residents	
Access to groundwater and rainwater*	N	%	N	%
Harvest rainwater	2,021	80	10,744	81
Do not harvest rainwater	502	20	2,444	19
Use groundwater	654	26	3,241	25
Harvest rainwater	405	16	*2,087*	*16*
Do not harvest rainwater	249	10	*1,154*	8.8
Do not use groundwater	1,869	74	*9,947*	*75*
Harvest rainwater	1,616	64	8,657	66
Do not harvest rainwater	253	10	1,290	10
Total	**2,523**		**13,188**	
Water storage tanks	1,831	73	9,717	74
1 storage tank	1,281	51	*6,622*	68
2 and 3 storage tanks	524	30	*2,953*	*30*
4 to 6 storage tanks	26	1,4	*142*	*1.5*
Total volume ≤ 500 L	1,170	46	6,069	*46*
Total volume from 500 to 1,000 L	435	17	*2,365*	*18*
Total volume from 1,000 to 3,000 L	209	8.3	*1,176*	8.9
Total volume greater than 3,000 L	17	0.7	*1,07*	0.8
Volume per capita ≤ 20 L	139	5	*944*	*7*
Volume per capita between 20 and 50 L	298	12	*1,968*	*15*
Volume per capita between 50 and 100 L	523	21	*3,090*	*23*
Volume per capital greater than 100 L	871	35	*3,715*	*28*
Do not have a water storage tank	690	27	3,439	26
Total	**2,521**	**100**	**13,156**	**100**
Drinking water storage containers*				
Bucket	1,003	31	5,481	34
PET bottles	988	30	5,099	31
Water tank	255	8	1,397	8.6
Mineral water gallon bottle	237	7.2	1,228	7.6
Clay pot	45	1.4	231	1.4
Others/not informed	1,248	38	6,542	40
Total	**3,285**		**16,212**	

Household treatment				
Treat water	2,302	89	12,127	90
Only hypochlorite	1,101	43	*5,644*	*42*
Cloth filtration + hypochlorite	487	19	*2,494*	*18*
Only cloth filtration	321	12	*1,752*	*13*
Decantation + cloth filtration + hypochlorite	97	3.7	*527*	*3,9*
Decantation + cloth filtration	82	3.2	*557*	*4.1*
Others	214	8.1	*1,153*	*9.0*
Do not treat water	287	11	1,385	10
Total	**2,589**	**100**	**13,512**	**100**

* Percentages may not sum to 100 as there could be more than one response per household

Source: Prepared by the authors.

Regarding the HWT (Figure 2, G, H, I), 89% of the families reported performing some type of water treatment, the most common being the use of hypochlorite (43%), followed by cloth filtration and hypochlorite (20 %) and just cloth filtration (12%). The use of water filters was reported in less than 1% of households.

Considering the WHO criteria (WHO, 2017b) most of the population (71% of the households in floodplains and 86% in non-floodable areas) have access to a basic water supply, as they have an improved water source at home (rainwater, well, or supply system), even though its safe management is not guaranteed (Table 3). The second most common situation is households with no water supply service (19% and 10% in floodplains and non-floodable areas, respectively), where the water is sourced directly from river or lake banks.

Table 3. Levels of access to water in riverine communities in the middle Solimões River region, Amazonas, Brazil (2018)

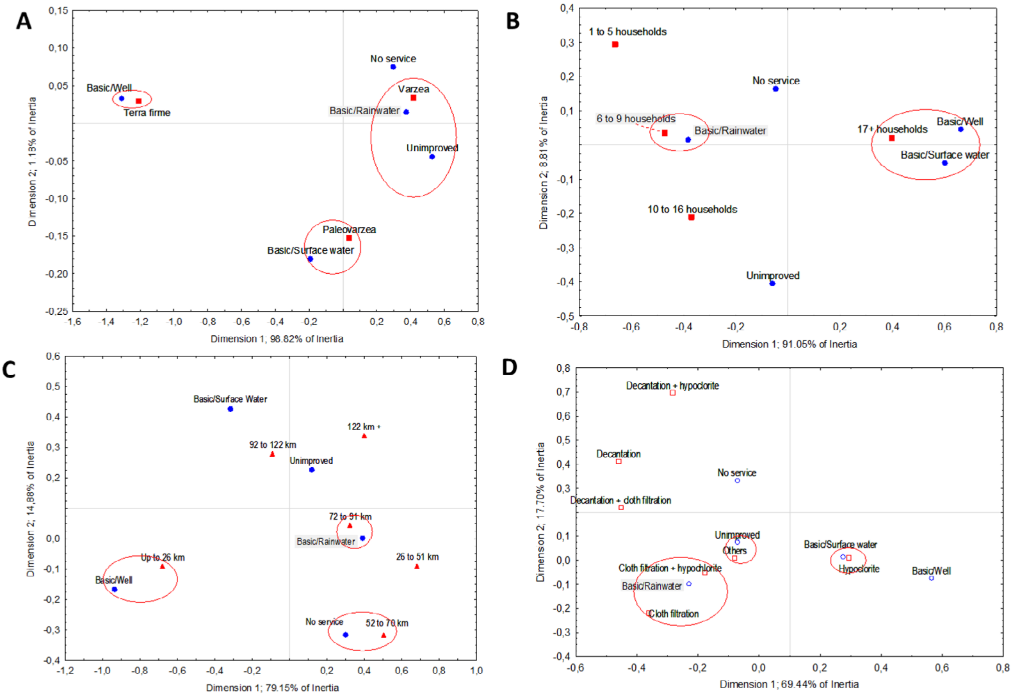
Level of access (WHO)	Sublevel (local cases)	Population in floodplain area		Population in non-floodable area	
		N	%	N	%
Safely managed		0	0	0	0
Basic	Rainwater	4,979	57.4	1,635	30
	Well water	227	2.6	2,080	38.2
	Treated surface water	926	10.7	953	17.5
Limited		0	0	0	0

Unimproved	928	10.7	223	4.1
Surface water	1,611	18.6	553	10.2
Total	**8,671**	100	**5,444**	100

Source: Prepared by the authors.

Correspondence analysis (Figure 3) was used to identify social and environmental factors associated with water use conditions.

Figura 3: The level of access to water and conditions of use were associated with (A) characteristics of the communities; (B) number of households in the community; (C) distance to the nearest urban center; and (D) household water treatment method using correspondence analysis



Source: Prepared by the authors.

The type of environment was found to influence the level of access to water (Figure 3A; $p < 0.05$). Households in non-flooded areas (terra firme) are associated with a well water supply, while households in floodplains consume rainwater, unimproved, or surface water. On the other hand, partially flooded areas (paleovárzea) are associated with the supply of treated surface water.

Community size, that is, the total number of households, was associated with better access to water (Figure 3B; $p < 0.05$). The largest communities (with more than 17 households) were associated with the existence of collective water supply systems (access levels Basic/Surface and Basic/Well).

Households located closer to urban centers (up to 26 km) were associated with access to well water (Figure 3C; $p < 0.05$). Indirectly, this situation was also observed in the association between the municipality that provides basic services to the community and the level of access to water, since it was found that being in the municipality of Alvarães was associated with the existence of wells. The municipalities of Maraã and Fonte Boa were associated with rainwater, surface, and unimproved water. Alvarães is the municipality whose communities are closest (on average 12 km), while Maraã and Fonte Boa are municipalities with more distant communities (83 and 89 km, respectively).

The level of access was associated with household water treatments (Figure 3D; $p < 0.05$). In places served by wells, there is no HWT. On the other hand, places with access to rainwater are associated with water treatment by cloth filtration and use of chlorine.

Households with access to rainwater are associated with a smaller total storage capacity, with volumes smaller than 500 liters, suggesting poor harvesting methods. Sites with a collective water supply system had the highest per capita water storage capacities (more than 100 l/person.day). The existence of a power generator in the community was also associated with a collective water supply system, whose operation usually depends on electric pumps.

The following variables were not associated with the level of access to water: characteristics of the household (number of rooms and type of walls); profile of the head of the household (gender and reading ability) and their spouse; per capita income; and variation of distance to the urban center in flood and dry seasons.

Discussion

The state of Amazonas has one of the lowest per capita budgets allocated to water supply in the country (FERREIRA et al., 2021). Thus, only 12% of the communities in the middle Solimões River region have some type of operational water supply system (Table 1). With little investment in collective solutions for the treatment of surface water, families resort to rainwater harvesting due to its availability and simple use. Among the communities, there is a great variation in the quality and types of rainwater harvesting facilities (GOMES, et al., 2011).

Despite being a traditional, common source of drinking water, used in 81% of households in the Mamirauá and Amanã SDR (Table 2), rainwater can be classified as “safe” or “improved”, but with reservations. Rainwater contamination may occur depending on the conditions of the roof and gutters and the presence of disease vectors such as birds and marsupials (HAMILTON et al., 2019). In the middle Solimões River region, vultures are commonly seen on the roofs of houses in both urban and rural areas. Vultures (Aves, Cathartidae) are birds of prey with opportunistic, scavenging habits. Their presence is associated with garbage, and they can be vectors of several diseases

(NOVAES and CINTRA, 2013).

Appropriate water collection and treatment methods, such as first flush divertion, filtration, and chemical or solar disinfection, should be sufficient to reduce the risk of rainwater contamination (GOMES et al., 2012; HAMILTON et al., 2019). These measures are relevant because the use of rainwater in poor conditions does not contribute to the improvement of water use conditions. Therefore, preventive measures to decrease the potential risks of rainwater should be shared with the population (BAGUMA et al., 2010).

As seen in Table 2, the low water storage capacity, total (46% of households with a capacity ≤ 500 l) and per capita (35% with storage ≥ 100 l/person.day), indicates that the volume is not enough for all domestic uses, especially during less rainy months (GOMES et al., 2019). For a typical family in the region with six people (SIMDE, 2018), the harvesting from a roof of 30 m^2 and use of 80% of the average rainfall (122 mm/month) in the drier period (August and September) would result in a total of 2,928 l/month – approximately 16 l/person.day.

According to the World Health Organization, 100 l/person.day of water is sufficient for drinking, food preparation, and hygiene purposes (HOWARD et al., 2020). A smaller amount than that impairs the quality and frequency of personal and domestic hygiene, becoming a risk to human health. In the Amazon context, with intermittent water supply systems, it is necessary to consider larger volume tanks in order to have water available at times when there is no rain or distribution, in the case of supply systems. Thus, the budget to improve access to water for riverine communities should include the purchase of larger water storage tanks or consider other improved sources of water collection.

The Brazilian Cisterns Program is a federal public policy for access to water that includes riverine communities. According to BERNARDES et al. (2018), in the Amazon, the technologies adopted by the Cisterns Program and their implementation processes were built in partnership with social movements and other institutions. By 2018, the Program had already installed 3,283 rainwater harvesting systems with tanks of 1,000 or 5,000 L, depending on the water supply situation in the community. The Program could potentially address many of the difficulties in accessing water identified in this study; nonetheless, it would not be enough to significantly change the scenario since there is a greater demand in the Amazon. In the micro-region of the Mamirauá and Amanã Sustainable Development Reserves alone, there are almost 10,000 residents (in approximately 1,700 households) who do not have access to water or have access from an unimproved source or rainwater (Table 2), but with insufficient storage volume.

In the middle Solimões River region, clay pots were traditionally used to store water until the 2000s (MOURA, 2007). Pots are currently handmade in a few communities in the region and, in addition to their fragility and cost, are no longer easily found in local markets. They have become rare over the years, being present in only 1% of households. Pots have been replaced by plastic PET bottles (30%), buckets (31%), tanks (8%), and mineral water bottles (7%). Moreover, cold drinking water is a priority for families that now use freezers or ice for this purpose (PENTEADO et al., 2019), contributing to their replacement.

Containers suitable for drinking water storage must have a lid, in addition to being easy to clean, resistant, and opaque to avoid altering the water quality due to the incidence of light (SOBSEY, 2002). PET bottles are suitable containers for being easy to clean; however, they need to be protected from light, as it promotes an increase in temperature and the growth of microorganisms. When stored in buckets, water protection from contamination depends on the existence of a lid and faucet or hand hygienization at the time of consumption.

The turbidity removal efficiency of the most common HWT techniques (Table 2) in the study region (decantation, cloth filtration, and use of hypochlorite) depend on the quality of the methods. Cloth filtration, for example, depends on the characteristics of the fabric and the number of filtration layers. The technique is used alone in 12% of households and combined with other ones in 26%. It is also associated with access to rainwater (Figure 3D). Sari cloth filtration removes particles larger than 20 μm (COLWELL et al., 2003). In Asian countries, the 12-layer cloth removes up to 50% of water turbidity, being indicated as a pre-treatment for solar disinfection (ALI et al., 2011).

Appropriate household water treatments have the potential to improve water quality in different contexts (LANTAGNE and CLASEN, 2012). To have a positive impact on health, nonetheless, there must be a regular and high adherence to the HWT (BROWN and CLASEN, 2012; SOBSEY, 2002).

Sodium hypochlorite (2.5% solution of active chlorine) is distributed free of charge by Community Health Agents who advise the population on the application dose. This may be the reason why, in the region, it is the most commonly used disinfection technique, being used as the only treatment and combined with others in 43% and 25% of households, respectively.

Despite the high percentage of families that reported its use, complaints from residents about the taste and odor of chlorinated water and stomach pains associated by themselves with water consumption are frequent. A study by CRIDER et al. (2018) showed that 50% of people cannot identify the taste of chlorine at concentrations lower than 0.7 mg/l. The recommended dose for disinfection of water with turbidity up to 10 NTU (equivalent to that of rainwater) is 1.85 mg/L and, for turbidity between 10 and 100 NTU, it can reach 3.75 mg/l of free chlorine (LANTAGNE, 2008). As a result, the actual regular use of sodium hypochlorite with the correct dose is uncertain in the region.

According to the national census data (IBGE), 54% of Brazilian households have a water filter (IBGE, 2016). However, in riverine communities in the middle Solimões River region, less than 1% of households reported the use of filters for household water treatment. This low number of filters may be associated with their cost and low availability in the local market, taking as a reference Tefé (AM) – the main urban center in the region.

The database analyzed in this research does not contain information on intermittent water supply collective systems. However, considering that these systems are managed locally by the riverine communities themselves and the source of electrical energy for water pumping is limited to three to four hours a day in the region (VALER et al., 2014), it is likely that water will not be constantly available in the supply system in these locations.

More than half the population of riverine communities that has access to groundwater (26%) also uses rainwater, representing 16% of the total households in this analysis. Moreover, even in households with surface water supply and rainwater harvesting, water directly from the rivers is used for domestic activities when there is a shortage of supply or in periods of little rainfall.

Access to multiple water sources is common in the rural context. In addition to intermittence, rural supply systems are affected by seasonality (HOWARD et al., 2020) characteristic that contributes to the population's search for more than one water source. The use of multiple sources is often disregarded in water supply planning. Despite representing a gap to be filled when it comes to access to water (ALEIXO et al., 2019), the use of multiple sources contributes to the resilience of the population in the contexts of climate change and efficient water use as well (ELLIOTT, et al., 2019).

As seen in Figures 3B and 3C, well water supply, which may be considered capable of meeting water quality and quantity needs, is associated with larger communities which are closer to urban centers.

The application of the levels of access to water established by the WHO (WHO, 2017b), using microdata from the middle Solimões River region (Table 3) and the analysis of Figure 3A, suggested disparities between the populations of floodplains (várzea) and non-floodable (terra firme and paleo-várzea) areas. The várzea people, despite being the majority in this study (61% of the total number of residents), lives under worse conditions of access to water and generally relies only on domestic rainwater harvesting, which is a system that varies in levels of water quality protection and has insufficient storage capacity, as previously discussed.

This difference may be explained by the existing difficulty in building in floodplains, which results in the nearly inexistent basic sanitation infrastructure in these areas (BERNARDES et al, 2018; GOMES et al., 2015; PACIFICO et al., 2021) and the impossibility of building wells due to the poor quality of groundwater and construction difficulties (AZEVEDO, 2006) Another reason may be because of the logistical challenges of the Amazon region such as the difficulty in transporting materials in dry seasons (low river water).

Knowledge of the conditions of domestic use of water in rural communities contributes to raising awareness and planning development programs for groups living under different access conditions (ALEIXO et al., 2016). Understanding the factors that influence these circumstances can contribute to the assessment of access to water and the budgetary decision-making, aiming at improving the quality of life in the Amazon.

Conclusion

In most riverine communities in the central Amazon, there is no water supply system. Rainwater is frequently used, being the main form of access to water for floodplain residents. For those living in non-floodable areas, groundwater and rainwater supply systems are the most common forms of access. Most households have a water storage tank; however, because of its small storage capacity, it is insufficient for all domestic uses. Household water treatments are common, being carried out mainly by disinfection with sodium hypochlorite, cloth filtration, and decantation. Nevertheless, the efficiency of these traditional methods is not guaranteed. Cloth filtration depends on the type of fabric and number of layers, while the efficiency of hypochlorite is influenced, for instance, by the dose used.

To tackle the challenges of access to water in flooded regions, technical and management arrangements that consider environmental aspects are necessary. Development projects for improving access to water must be tailored to the situation of this region, including elements of rainwater use and complementary sources that can be used individually (per household), collectively, or in a combination of both. Moreover, those projects must consider the use of efficient household water treatment technologies, as well as adequate and safe storage.

Acknowledgement

The authors thank to Ministry of Science, Technology and Innovations (MCTI/ Federal Government) and to National Council for Scientific and Technological Development (CNPq).

References

ALEIXO, B.; PENA, J. L.; HELLER, L.; REZENDE, S. Human right in perspective: Inequalities in access to water in a rural community of the brazilian northeast. **Ambiente & Sociedade**, v. 19, n. 1, p. 63–84, 2016.

ALEIXO, B.; REZENDE, S.; PENA, J. L.; ZAPATA, G.; HELLER, L.Infrastructure is a necessary but insufficient condition to eliminate inequalities in access to water: Research of a rural community intervention in Northeast Brazil. **Science of the Total Environment**, v. 652, n. October, p. 1445–1455, 2019.

ALI, S. I.; MACDONALD, M.; JINCY, J.; SAMPATH, K. A.; VINOTHINI, G.; PHILIP, L.; … ARONSON, K. Efficacy of an appropriate point-of-use water treatment intervention for low--income communities in India utilizing Moringa oleifera , sari-cloth filtration and solar UV disinfection. **Journal of Water, Sanitation and Hygiene for Development**, v. 1, n. 2, p. 112, 2011.

ANDERSON, D. M.; GUPTA, A. K.; BIRKEN, S.; SAKAS, Z.; FREEMAN, M. C.. Successes, challenges, and support for men versus women implementers in water, sanitation, and hygiene programs: A qualitative study in rural Nepal. **International Journal of Hygiene and Environmental Health**, v. 236, p. 113792, jul. 2021..

AZEVEDO, R. P. De. Uso de água subterrânea em sistema de abastecimento público de comunidades na várzea da Amazônia central. **Acta Amazonica**, v. 36, n. 3, p. 313–320, 2006.

BAGUMA, D.; LOISKANDL, W.; JUNG, H. Water Management, Rainwater Harvesting and Predictive Variables in Rural Households. **Water Resources Management**, v. 24, n. 13, p. 3333–3348, 2010.

BERNARDES, R. S.; COSTA, A. A. D. Da; BERNARDES, C. Sanear Amazônia Project: social technologies and protagonism of communities improve quality of life in the extractive reserves. **Desenvolvimento e Meio Ambiente**, v. 48, n. Edição especial: 30 anos do Legado de Chico Mendes, p. 263–280, 2018.

BISUNG, E.; ELLIOTT, S. J. Psychosocial impacts of the lack of access to water and sanitation in low- and middle-income countries: A scoping review. **Journal of Water and Health**, v. 15, n. 1, p. 17–30, 2017.

BRASIL. Ministério da saúde. Portaria GM 888 de 4 de maio de 2021. Altera o Anexo XX da Portaria de Consolidação GM/MS nº 5, de 28 de setembro de 2017, para dispor sobre os procedimentos de controle e de vigilância da qualidade da água para consumo humano e seu padrão. **Diário Oficinal da União**, Brasília, DF, 2021.

BROWN, J.; CLASEN, T. High adherence is necessary to realize health gains from water quality interventions. **PLoS ONE**, v. 7, n. 5, p. 1–9, 2012.

BROWN, J.; PROUM, S.; SOBSEY, M. D. Sustained use of a household-scale water filtration device in rural Cambodia. **Journal of Water and Health**, v. 7, n. 3, p. 404–412, 2009.

CAMPOS-SILVA, J. V, HAWES, J. E.; ANDRADE, P. C. M.; PERES, C. A. Unintended multispecies co-benefits of an Amazonian community-based conservation programme. **Nature Sustainability**, n. November, 2018.

CLASEN, T.; NARANJO, J.; FRAUCHIGER, D.; GERBA, C. Laboratory assessment of a gravity-fed ultrafiltration water treatment device designed for household use in low-income settings. **American Journal of Tropical Medicine and Hygiene**, v. 80, n. 5, p. 819–823, 2009.

CODEÇO, C. T.; ASTA, A. P. D.; RORATO, A. C.; LANA, R. M.; NEVES, T. C.; ANDREAZZI, C. S.; … SILVA-NUNES, M. Epidemiology, Biodiversity, and Technological Trajectories in the Brazilian Amazon: From Malaria to COVID-19. **Frontiers in Public Health**, v. 9, n. July, 2021.

COLWELL, R. R.; HUQ, A.; ISLAM, M. S.; AZIZ, K. M. A.; YUNUS, M.; HUDA KHAN, N.; … RUSSEK-COHEN, E. Reduction of cholera in Bangladeshi villages by simple filtration. **Proceedings of the National Academy of Sciences of the United States of America**, v. 100, n. 3, p. 1051–1055, 2003.

CRIDER, Y.; SULTANA, S.; UNICOMB, L.; DAVIS, J.; LUBY, S. P.; PICKERING, A. J. Can you taste it? Taste detection and acceptability thresholds for chlorine residual in drinking water in Dhaka, Bangladesh. **Science of the Total Environment**, v. 613–614, p. 840–846, 2018.

DICKIN, S.; BISUNG, E.; NANSI, J.; CHARLES, K. Empowerment in water, sanitation and hygiene index. **World Development**, v. 137, p. 105158, jan. 2021.

ELLIOTT, M.; FOSTER, T.; MACDONALD, M. C.; HARRIS, A. R.; SCHWAB, K. J.; HADWEN, W. L. Addressing how multiple household water sources and uses build water resilience and support sustainable development. **npj Clean Water**, v. 2, n. January, dez. 2019.

FERREIRA, D. C.; GRAZIELE, I.; MARQUES, R. C.; GONÇALVES, J.Investment in drinking water and sanitation infrastructure and its impact on waterborne diseases dissemination: The Brazilian case. **Science of the Total Environment**, v. 779, p. 146279, 2021.

FITHIAN, W.; JOSSE, J. Multiple correspondence analysis and the multilogit bilinear model. **Journal of Multivariate Analysis**, v. 157, p. 87–102, 2017.

FRANCO, C. L. B.; EL, H. R.; ROBERTO, P.; FA, J. E. Community-based environmental protection in the Brazilian Amazon: Recent history , legal landmarks and expansion across protected areas. **Journal of Environmental Management**, v. 287, n. March, 2021.

GEERE, J.; BARTRAM, J.; BATES, L.; DANQUAH, L.; EVANS, B.; FISHER, M. B.; GROCE, N.; MAJURU, B.; MOKOENA, M.; MUKHOLA, M. S.; NGUYEN-VIET, H.; DUC, P. P.; WILLIAMS, A. R.; SCHMIDT, W.; HUNTER, P. R. Carrying water may be a major contributor to disability from musculoskeletal disorders in low income countries: a cross-sectional survey in South Africa, Ghana and Vietnam. **Journal of Global Health**, v. 8, n. 1, 2018.

GOMES, M. C. R. L.; MOURA, E. A. F.; BORGES PEDRO, J. P.; BEZERRA, M. M.; BRITO, O. S. Sustainability of a sanitation program in flooded areas of the Brazilian Amazon. **Journal of Water, Sanitation and Hygiene for Development**, v. 5, n. 2, p. 261–270, jun. 2015.

GOMES, M. C. R. L.; NASCIMENTO, A. C.; CORRÊA, D. S. S.; CHAGAS, H. C. DAS. Uso de água de chuva para consumo em localidade ribeirinhas da Amazônia, Brasil. SIMPÓSIO BRASILEIRO DE MANEJO E CAPTAÇÃO DE ÁGUA DE CHUVA, 9º. Feira de Santana, BA. **Anais**..., 2011.

GOMES, M.; NASCIMENTO, A. C. S. DO, CORRÊA, D. S. DE S.; BRITO, O. S.; MOURA, E. A. F. Surrounded by sun and water: development of a water supply system for riverine peoples in Amazonia. **Revista Tecnologia e Sociedade**, v. 15, n. 35, jan. 2019.

GOMES, U.; PENA, J. L.; HELLER, L. A National Program for Large Scale Rainwater Harvesting: An Individual or Public Responsibility? **Water Resources Management**, v. 26, p. 2703–2714, 2012.

HAMILTON, K.; REYNEKE, B.; WASO, M.; CLEMENTS, T.; NDLOVU, T.; KHAN, W.; … AHMED, W. A global review of the microbiological quality and potential health risks associated with roof-harvested rainwater tanks. **npj Clean Water**, v. 2, n. 1, dez. 2019.

HOWARD, G.; BARTAM, J.; WILLIAMS, A.; OVERBO, A.; FUENTE, D.; GEERE, J.-A. **Domestic water quantity, service level and health,** 2. ed. Geneva: World Health Organization, 2020.

IBGE - INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. **Pesquisa Nacional por Amostra de domicílios - Síntese de Indicadores 2015**, 2016.

INMET - INSTITUTO NACIONAL DE METEREOLOGIA. **Dados Históricos: Banco de Dados Meteorológicos**, 2021.

JOLY, C. A.; SCARANO, F. R.; SEIXAS, C. S.; METZGER, J. P.; OMETTO, J. P.; BUSTAMANTE, M. M. C.; … PADGURSCHI, M. C. G. **1o Diagnóstico Brasileiro de Biodiversidade & Serviços Ecossistêmicos**. BPBES, 2019.

JUNK, W. J.; PIEDADE, M. T. F.; SCHÖNGART, J.; WITTMANN, F . A classification of major natural habitats of Amazonian white-water river floodplains (várzeas). **Wetlands Ecology and Management**, v. 20, n. 6, p. 461–475, nov. 2012. Disponível em: <https://link.springer.com/article/10.1007/s11273-012-9268-0>. Acesso em: 13 abr. 2021.

KELLY, E.; SHIELDS, K. F.; CRONK, R.; LEE, K.; BEHNKE; KLUG, T.; BARTRAM, J.; et al. Seasonality, water use and community management of water systems in rural settings: Qualitative evidence from Ghana, Kenya, and Zambia. **Science of the Total Environment**, v. 628–629, n. February, p. 715–721, 2018.

LANTAGNE, D. Sodium hypochlorite dosage for household and emergency water treatment. **Journal AWWA**, v. 100, n. 8, 2008.

LANTAGNE, D. S.; CLASEN, T. F. Use of household water treatment and safe storage methods in acute emergency response: Case study results from Nepal, Indonesia, Kenya, and Haiti. **Environmental Science and Technology**, v. 46, n. 20, p. 11352–11360, 2012.

LEE, R. **Water purification for rural communities using ultraviolet light and bleach systems**. University of Arkansas, 2011.

MELACK, J. M.; HESS, L. L. Remote Sensing of the Distribution and Extent of Wetlands in the Amazon Basin. In: JUNK, W. J. et al. (Org.). **Amazonian Floodplain Forests: Ecophysiology, Biodiversity and Sustainable Management**. Dordrecht: Springer Netherlands, p. 43–59, 2011.

MINGOTI, S. A. **Análise de dados através de métodos de estatística multivariada: uma abordagem aplicada**. Belo Horizonte: Editora UFMG, 2005.

MOURA, E. A. F. Water to drink, water to cook, water to bath: socioambiental diversities regarding consumption of water among the inhabitants of the fertile valley of Mamirauá, Amazon state. **Cadernos de Saúde Coletiva**, v. 15, n. 4, p. 501–516, 2007.

MOURA, E. A. F.; NASCIMENTO, A. C. S. DO, CORRÊA, D. S. DE S.; ALENCAR, E. F.; SOUSA, I. S. DE. **Sociodemografia da Reserva de Desenvolvimento Sustentável Mamirauá: 2001- 2011**. Tefé, AM, 2016.

NOBRE, C. A.; SAMPAIO, G.; BORMA, L. S.; CASTILLA-RUBIO, J. C.; SILVA, J. S.; CARDOSO, M. Land-use and climate change risks in the Amazon and the need of a novel sustainable development paradigm. **PNAS**, v. 113, n. 39, p. 10759–10768, 2016.

NOVAES, W. G.; CINTRA, R. Factors influencing the selection of communal roost sites by the Black Vulture Coragyps atratus (Aves: Cathartidae) in an urban area in Central Amazon. **Zoologia**, v. 30, n. 6, p. 607–614, 2013.

OYANEDEL-CRAVER, V. A.; SMITH, J. A. Sustainable colloidal-silver-impregnated ceramic filter for point-of-use water treatment. **Environmental Science and Technology**, v. 42, n. 3, p. 927–933, 2008.

PACIFICO, A. C. N.; NASCIMENTO, A. C. S. DO, CORRÊA, D. S. S.; PENTEADO, I. M.; PEDRO, J. P. B.; GOMES, M. C. R. L.; GOMES, U. A. F. Tecnologia para acesso à água na várzea amazônica: impactos positivos na vida de comunidades ribeirinhas do Médio Solimões, Amazonas, Brasil. **Cadernos de Saúde Pública**, v. 37, n. 3, 2021.

PENTEADO, I. M. et al. Among people and artifacts: Actor-Network Theory and the adoption of solar ice machines in the Brazilian Amazon. **Energy Research and Social Science**, v. 53, p. 1–9, jul. 2019.

PERALTA, N.; LIMA, D. D. M. A comprehensive overview of the domestic economy in Mamirauá and Amanã in 2010. **UAKARI**, v. 9, n. 2, p. 33–62, jan. 2013.

POOI, C. K.; NG, H. Y. Review of low-cost point-of-use water treatment systems for developing communities. **npj Clean Water**, v. 1, n. 1, dez. 2018.

PRÜSS-USTÜN, A.; BARTRAM, J.; CLASEN, T.; COLFORD, J. M.; CUMMING, O.; CURTIS, V.; … CAIRNCROSS, S. Burden of disease from inadequate water, sanitation and hygiene in low- and middle-income settings: a retrospective analysis of data from 145 countries. **Tropical Medicine & International Health**, v. 19, n. 8, p. 894–905. ago. 2014.

RAM, P. K.; KELSEY, E.; RASOATIANA, MIARINTSOA, R. R.; RAKOTOMALALA, O.; DUNSTON, C.; QUICK, R. E. Bringing safe water to remote populations: An evaluation of a portable point-of-use intervention in rural Madagascar. **American Journal of Public Health**, v. 97, n. 3, p. 398–400, 2007.

SIMDE. **Reserva de Desenvolvimento Sustentável Amanã e Amanã**. Banco de dados. Tefé-AM, 2018.

SIWILA, S.; BRINK, I. C. Comparative analysis of two low cost point-of-use water treatment systems. **Water Practice & Technology**, v. 13, n. 1, p. 79–90, 2018.

SOBSEY, M. D. **Managing Water in the Home: Accelerated Health Gains from Improved Water Supply**. World Health Organization. Geneva, 2002.

SOBSEY, M. D.; HANDZEL, T.; VENCZEL, L. Chlorination and safe storage of household drinking water in developing countries to reduce waterborne disease. **Water Science and Technology**, v. 47, n. 3, p. 221–228, 2003.

SOBSEY, M. D.; STAUBER, C. E.; CASANOVA, L. M.; BROWN, J. M.; ELLIOTT, M. A.; CAROLINA, N. Point of Use Household Drinking Water Filtration: A Practical, Effective Solution for Providing Sustained Access to Safe Drinking Water in the Developing World. **Environmental Science & Technology**, v. 42, n. 12, p. 4261–4267, 2008.

STRAND, J.; SOARES-FILHO, B.; COSTA, M. H.; OLIVEIRA, U.; RIBEIRO, S. C.; PIRES, G. F.; … TOMAN, M. Spatially explicit valuation of the Brazilian Amazon Forest's Ecosystem Services. **Nature Sustainability**, v. 1, n. 11, p. 657–664, 2018.

THE RAMSAR CONVENTION. **The List of Wetlands of International Importance**. 2021.

UNITED NATIONS. **The human right to water and sanitation**. Resolution 64/292. United Nations, 2010.

VALER, L. R.; MOCELIN, A.; ZILLES, R.; MOURA, E.; NASCIMENTO, A. C. S. Assessment of socioeconomic impacts of access to electricity in Brazilian Amazon: Case study in two communities in Mamirauá Reserve. **Energy for Sustainable Development**, v. 20, n. 1, p. 58–65, 2014.

WHO. **Guidelines for drinking-water quality: fourth edition incorporating the first addendum.** 1. ed. Geneva: World Health Organization, 2017a.

WHO. **Safely managed drinking water: thematic report on drinking water 2017**. World Health Organization. Geneva, 2017b.

Maria Cecilia Rosinski Lima Gomes

✉ engceciliagomes@gmail.com

ORCiD: https://orcid.org/0000-0003-0108-0148

Submitted on: 18/10/2021

Accepted on: 16/05/2022

2022;25e:01782

Leonardo Capeleto de Andrade

✉ leonardo.andrade@mamiraua.org.br

ORCiD: https://orcid.org/0000-0002-9902-0532

Ana Claudeise Silva do Nascimento

✉ anaclaudeise@unifesspa.edu.br

ORCiD: https://orcid.org/0000-0002-3068-1324

João Paulo Borges Pedro

✉ joaopaulo.pedro@hotmail.com

ORCiD: https://orcid.org/0000-0002-9735-8871

Cesar Rossas Mota Filho

✉ crmota@gmail.com

ORCiD: https://orcid.org/0000-0002-3538-8856

AMBIENTE & SOCIEDADE
25 anos / años / years

SciELO

Condições de uso e níveis de acesso domiciliar à água em comunidades rurais na Amazônia

Maria Cecilia Rosinski Lima Gomes
Leonardo Capeleto de Andrade
Ana Claudeise Silva do Nascimento
João Paulo Borges Pedro
Cesar Rossas Mota Filho

São Paulo. Vol. 25, 2022

Artigo Original

Resumo: O acesso à água é um direito humano e um Objetivo do Desenvolvimento Sustentável (ODS) da ONU. Porém, em comunidades ribeirinhas da região Norte do Brasil predomina a carência de abastecimento de água e outros serviços públicos. O objetivo deste estudo foi analisar as condições de uso domiciliar de água em comunidades ribeirinhas da Amazônia Central e classificar o nível de acesso segundo a Organização Mundial da Saúde. Foram avaliados dados secundários de 3.285 domicílios de áreas alagáveis e não alagáveis, na área das Reservas de Desenvolvimento Sustentável Mamirauá e Amanã. Foram utilizadas estatística descritiva e análise de correspondência simples. Identificou-se que 71% da população possui nível básico de acesso à água, com captação de água de chuva e tratamento domiciliar com hipoclorito. Para melhorar o acesso é necessário investimento em melhoria da captação de água de chuva e uso de fontes complementares, com arranjos individuais (por domicílio) ou coletivos.

***Palavras-chave*:** Acesso à água, tratamento domiciliar de água, população rural, Amazônia, várzea.

AMBIENTE & SOCIEDADE 25 anos años years

Condiciones de uso y niveles de acesso doméstico del agua en comunidades rurales de la Amazonía

Maria Cecilia Rosinski Lima Gomes
Leonardo Capeleto de Andrade
Ana Claudeise Silva do Nascimento
João Paulo Borges Pedro
Cesar Rossas Mota Filho

São Paulo. Vol. 25, 2022
Artículo Original

Resumen: El acceso al agua es un derecho humano y un Objetivo de Desarrollo Sostenible (ODS) de la ONU. Sin embargo, en las comunidades ribereñas del norte de Brasil predomina la falta de suministro de agua y otros servicios públicos. El objetivo de este estudio fue analizar las condiciones de uso domiciliario del agua en comunidades de la Amazonía Central y clasificar el nivel de acceso según la Organización Mundial de la Salud. Se evaluaran datos secundarios de 3.285 viviendas en áreas inundadas y no inundadas en las Reservas de Desarrollo Sostenible Mamirauá y Amanã. Se utilizo estadística descriptiva y análisis de correspondencia simples. Se identificó que el 71% de la población presentó un nivel básico de acceso al agua, con captación de agua de lluvia y tratamiento domiciliario con hipoclorito. Para mejorar este acceso, será necesario invertir en la captación de agua de lluvia y el uso de fuentes complementarias, con arreglos por hogar o colectivos.

Palabras-clave: Acceso al agua, tratamiento del agua a nivel domiciliar, población rural, Amazonia, bosque inundable.

AMBIENTE & SOCIEDADE 25 anos años years

ERRATUM

In the article Conditions of use and levels of household access to water in rural communities in the Amazon, with the DOI: http://dx.doi.org/10.1590/1809-4422asoc20210178r12vu2022L4OA, published in the journal Revista Ambiente & Sociedade, Vol 25, On page 01

Which read:

Abstract: This work sought to analyze the health and environment in the Brazilian municipalities that make up the Frontier Strip (FS), considering the unique challenges of managing these in such territory. For this purpose, the association between them was studied by collecting and analyzing secondary data, using descriptive statistics, mapping, and cluster analysis. The main results demonstrated the lack of public policies, particularly for environmental and health issues in activities of municipal border governments, and the discussions that incorporate intersectionality in planning are even more limited. Of the 94.7% of municipalities analyzed, 53.6% presented an average performance on the environmental issue, and 81.3% a low or very low one on health, probably due to the fact that environmental aspects have gained more attention in the context of Brazilian FS compared to health ones. Finally, the study points out the implications of these results, which can subsidize public policies.

Read:

Abstract: Access to water is a human right and a UN Sustainable Development Goal (SDG). However, in riverine communities in northern Brazil, there is a prominent lack of water supply and other public services. This study aimed to analyze the conditions of household water use in riverine communities in the Central Amazon and classify their level of access to clean water according to those established by the World Health Organization (WHO). Secondary data from 3,285 households in floodable and non-floodable areas in the Mamirauá and Amanã Sustainable Development Reserves were evaluated. The analysis was performed using descriptive statistics and simple correspondence analysis. It was found that 71% of the population has basic access to water, with rainwater harvesting and chlorine point-of-use treatment. To improve access to water, investments are needed for the improvement of rainwa-ter harvesting systems and the use of complementary water sources, be it collectively or individually (per household).