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Water and Women's Participation The Case of One Million Rural Cisterns Program in Serra Talhada, Pernambuco

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Keywords

Gender, Water, Policies, Participation, Semiarid

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The Case of One Million Rural Cisterns Program in Serra Talhada, Pernambuco

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INTRODUCTION

Providing safe drinking water to rural areas in the developing world is a significant problem for policymakers. The need for water continues to increase as a result of population growth, particularly in developing countries, along with domestic, agricultural, and industrial development (Bennett, Dávila-Poblete & Rico, 2008; Baguma et al., 2013; Kevany & Huisinsh, 2013). According to Mekonnen and Hoekstra (2016), four billion people currently experience water scarcity for at least one month of the year. Around 748 million people lack access to an improved drinking-water source (WHO & UNICEF, 2014).

Access to freshwater resources has a direct impact on women's lives, infant mortality and morbidity, children's health, and consequently the wellbeing of the entire family unit (Singh et al, 2003; Leite, 2010; Singh & Wickenberg, 2017). Scholars and activists point to the human dimension of water issues by calling attention to social inequalities in water access, but also in water-related decision-making processes (Barlow, 2007). In poor rural areas of developing countries where water provision remains largely an individual or

household responsibility, women and girls are the primary providers, managers, and users of water (Laurie, 2011; Oyanedel-Craver, et al., 2017).

As a result of prevailing social norms, most decision-makers in water policy and management arenas have been men, with women having limited influence (Carrard et al., 2013; Moraes & Rocha, 2013). Over the last four decades, many studies have examined women's roles in water management, demonstrating that equal participation of both men and women substantially improves the governance, transparency, and sustainability of water supplies (Rautanen & Baaniya, 2008; Moraes & Rocha, 2013; Mandara, Niehof & Horst, 2017).

At the fundamental level of policy formulation, there is widespread consensus about the importance of including women in the creation of water policies. Adoption of international agreements such as the 1992 Dublin Principles brought notable changes in water management, including a focus on women as water users and managers (Harris & Gantt, 2007; Grant et al., 2016). Excluding women from the decision-making process is now recognized as a major obstacle to improving their well-being and achieving the Sustainable Development Goals in the developing world (O'Reilly, 2010; Grant et al., 2016).

In Brazil, only around 30% of households in rural areas have access to clean water (Ministério das Cidades, 2016). The semi-arid region in the northeast suffers the most from water-related problems. This region is characterized by the nation's highest solar radiation, a high evapotranspiration rate, irregular rainfall distribution, and shallow rocky soils, resulting in low water-storage capacity (Marengo, 2008; Oliveira & Sobral, 2012; Gutiérrez et al., 2014).

Historically, the semi-arid region has had Brazil's largest concentration of rural poverty, where lack of adequate sanitation and clean water is prevalent (Figueiredo & Perkins, 2013). As a group, women are the most affected by this structural inequality (Cirilo, 2008; Marengo, 2008; Figueiredo & Perkins, 2013).

In this article, we report on the results of a case study analyzing women's participation in a water program in Serra Talhada, Pernambuco, located in northeast Brazil. The study investigates how rural women in the One Million Rural Cisterns Program (P1MC) can contribute to more sustainable water management at the domestic and community levels. We consider perspectives from the organizations working in the program, and from the women beneficiaries of the program.

WATER AND GENDER

The analysis of gender issues in water resource management and the inclusion of this theme in the design and implementation of public policies has received increasing attention from scholars and policy makers (Meinzen-Dick & Zwarteveen, 1998; Elmhirst & Resurreccion, 2008; Aladuwaka & Momsen, 2010; Tibesigwa, Visser, Hunter, Collinson & Twine, 2015).

In the field of development studies, water and gender have become crucial themes when examining sustainability issues (Aladuwaka & Momsen, 2010; Grant et al., 2016). In 2000, water and gender related issues were recognized by the United Nations as a major global challenge, primarily in developing countries (Wallace & Porter, 2010; Sachs, 2012). Both were included in the Millennium Development Goals (MDGs) and in the current UN Sustainable Development Goals (SDGs) agenda. Those SDGs relating to water and gender aim to reduce the proportion of people without access to safe water and adequate sanitation

(Goal 6), and to achieve gender equality and empower all women and girls (Goal 5) (Grant et al., 2016; Arubayi & Arubayi, 2016).

Water is gendered in every society (Wallace & Coles, 2005), a point that shows the interdependency between the fifth and sixth Sustainable Development Goals. Achieving universal access to water requires prioritizing the needs of marginalized individuals and groups. In this case, women bear the burden of gender inequalities. Early problem-solving approaches relating to women and development recognized this problem; however, the process of achieving women's participation in decision-making remains a slow one, including those processes of design, implementation, and management of development policies in the field (Singh, 2006; Ray, 2007; Yerian, Henink & Greene, 2014). The paradox between the vital role of women in water management and their lack of access to this resource is striking and often reinforced by policies and development programs that ignore the unique needs and interests of rural women, especially those in developing countries (Singh, 2006; Laurie, 2011; Moraes & Rocha, 2013).

In Brazil, as in many parts of South America, water policy affecting household use is often associated with women as domestic users, while "productive" use of water (e.g. irrigation) is associated with men (Cordeiro et al., 2012). Despite working on the land as farmers, women and their specific duties are unrecognized in the sphere of policymaking (Meinzen-Dick & Zwarteveen, 1998; Branco, 2000; Laurie, 2011; Cordeiro et al., 2012). Furthermore, there are still many race- and class-based barriers to women's active participation in the water management sector (Moraes & Perkins, 2007; Laurie, 2011). Many studies report the changes occurring via women's activism and growing female involvement in NGOs and local associations (Moraes & Perkins, 2007; Esquivel, 2016; Grant et al., 2016; Oy-

anedel-Craver et al., 2017); but Boateng and Tenkorang (2013) argue that more attention should be paid to women's actual participation in development.

To gain a better understanding of gender issues in the water sector, we need to consider women not just as mere domestic managers of water, but as fully enfranchised and empowered community members and decision-makers (O'Reilly, 2006; Moraes & Perkins, 2007; Laurie, 2011). In the following sections, we analyze the One Million Rural Cisterns Program in Brazil, with a gendered focus. We concentrate on women's inclusion in the program, gender roles in the provision and use of water in the household, and the broader participation of women in the community.

The One Million Rural Cisterns Program in Serra Talhada, Pernambuco state, Brazil

Brief Characterization of the P1MC

One Million Rural Cisterns (P1MC) is a program created by the ASA – Articulação para o semiárido brasileiro (in English Brazilian Semi-Arid Network). The ASA is a network that links approximately three thousand organizations, including rural unions, farmers associations, cooperatives, NGOs, and Public Interest Civil Society Organizations (OSCIP).

The network was created during the 3rd Conference of the Parties of the Convention to Combat Desertification, held in Recife, Brazil, in 1999 (Gomes & Pena, 2012). The forum laid out principles for sustainable living in the semi-arid environment and ending the monopolization of resources (TCU, 2006; Duque,

2008; Pontes, 2013). The ASA was constituted to facilitate political arrangement in the Brazilian semi-arid region, with the aim of formulating and implementing water management policies appropriate to the local context while decentralizing government decisions (Silva, 2003). The ASA proposes the concept of a coexistence between the local population and the Caatinga biome. Two important pillars in this proposal are the conservation and sustainable use of natural resources, and the dismantling of monopolies on land, water, and other means of production (Moraes & Rocha, 2013; Pérez-Marin et al., 2016). This new idea emerged as a criticism of previous policies, highlighting their inadequacy in sustaining the region's population and environment (Gomes & Pena, 2012; Moraes & Rocha, 2013).

Following this meeting in 1999, the One Million Rural Cisterns Program was born, and ultimately became one of the largest rainwater-harvesting programs in Brazil. In 2003, the Brazilian government agreed to incorporate the program into federal policies (TCU, 2006; Gomes & Pena, 2012, Pontes, 2013). The program has received governmental support as part of its Zero Hunger strategy, following negotiations between the ASA and the federal government (Moraes & Rocha, 2012).

The program's main goal is to mobilize communities and build plaque cisterns for one million families, which represents roughly half of all people in the Brazil's semi-arid region without adequate access to clean drinking water (Nascimento, 2005; Passador & Passador, 2010). Additionally, the objectives of P1MC include tackling rural poverty, promoting citizenship, and strengthening civil society organizations. The scope of the project encompasses the semi-arid regions in the states of Alagoas, Bahia, Ceará, Maranhão, Minas Gerais, Paraíba, Pernambuco, Piauí, Rio Grande do Norte, and Sergipe (AP1MC, 2012).

Responsible stakeholders of ASA invited technicians and academics to rural areas to



Figure 1. Social technology: The cistern Source: Islene Façanha, field work, 2017

develop the network's training and mobilization proposals. The municipal committee and local NGOs selected families likely to benefit the most, considering the number of cisterns to be built, with the following criteria in order of priority (CGU, 2011):

1. Households headed by women;
2. Number of children below 6 years old;
3. Children and adolescents at school;
4. Presence of individuals with special needs;
5. Presence of adults aged 65 or above;

Families are considered based on enrollment in the Single Registration (in Portuguese *Cadastro Único*, or *CadÚnico*¹) for social programs (CGU, 2011). Through these criteria, the program seeks to include society's most vulnerable groups with a particular focus on empowering women.

This valorization of the female figure is important given women's historical struggle for water and land ownership, and the oppor-

¹ *CadÚnico* is a tool for socioeconomic identification and characterization of low-income families in Brazil. Available at: <https://portal.tcu.gov.br/biblioteca-digital/audit-on-the-unified-registry-system-cadastro-unico-3.htm>

tunity to improve development in the rural environment (Branco, 2000; Moraes & Rocha, 2013). For women, formally claiming the right to land and water and taking an active role in resource management challenges the status quo. For many communities like the one studied here, prevailing gender norms and gendered responsibilities at the household and community levels contribute to the continual neglect of female value (Meinzen-Dick & Zwarteveen, 1998; Moraes & Gonçalves, 2016).

The cistern: A Social Technology

Many types of cisterns have been used to store rainwater in Brazil's semi-arid region. This program uses a cylindrical cement plate cistern model due to its simplicity, low cost, and durability adapted to environmental conditions (TCU, 2006). Rainwater falling on the roofs of houses is captured by gutters and directed to the cistern through polyvinyl chloride pipes (Gomes et al., 2014). The cisterns are constructed near the homes of low-income families to facilitate ease of access. The cisterns were modified in 2004 with the

addition of manual pumps to avoid contamination associated with traditional bucket withdrawal (TCU, 2006).

By easing the work required of women to collect water, cistern technology provided a significant advantage by increasing the freedom of poor communities, where previously they had been 'trapped' in dealings with local politicians and owners of dams and water trucks (Pontes & Machado, 2009; Dias, 2013). These families had often been indebted to landowners, who acted as gatekeepers to clean water (Pontes & Machado, 2009; Gomes et al., 2014).

According to the ASA, important programs involving social technologies for water extraction are those which can coexist with the semi-arid community, such as the One Million Rural Cisterns Program (P1MC); A Land and Two Waters (P1 + 2), a strategy to expand the scope of the P1MC; and Cisterns in Schools (Fundação Banco do Brasil, 2014). These projects present a philosophy focused on the coexistence of society and nature. "P1 + 2", popularly known as "Second Water", was created alongside P1MC. It aims to ensure that rural populations have access to land and water sufficient to meet their domestic and agricultural needs. A second element of their mission is to reduce the inherent risks in agricultural undertakings, such as losses in agricultural production and livestock as a result of temporary or unpredictable resource shortages (Duque, 2008; Brito et al, 2010).

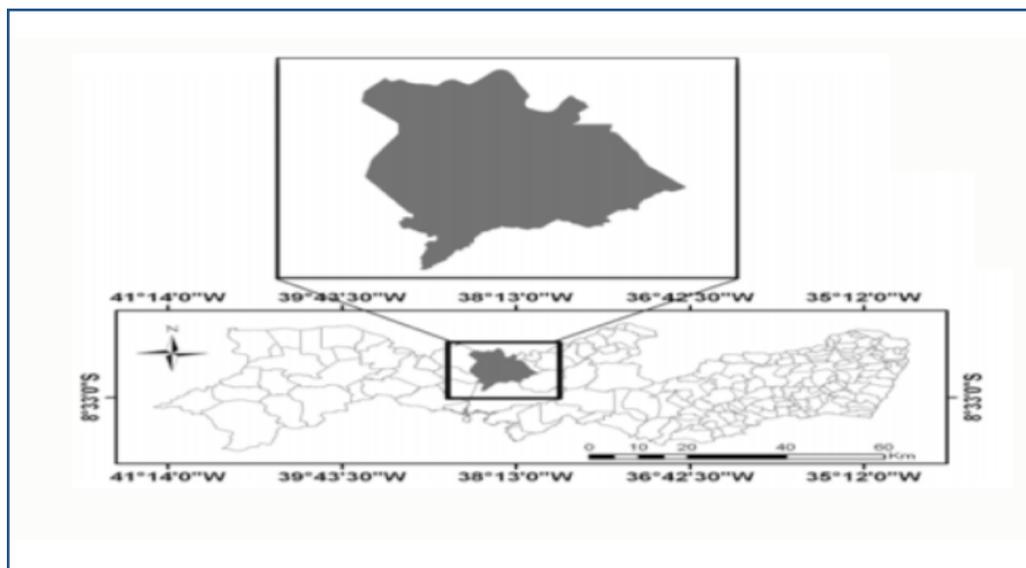


Figure 2. Municipality of Serra Talhada, Source: Embrapa, 2014

Characteristics of the study area

Geographic, Climatic and Hydrologic Conditions

The case study area is Serra Talhada, located in the semi-arid region of northeast Brazil. The area covers the northern Pajeú micro-region in the State of Pernambuco, about 515 km from Recife, and spans an area of approximately 3,000,000 km² (IBGE, 2016). It is bordered to the north by the state of Paraíba, Floresta to the south, Calumbi, Betânia, and Santa Cruz da Baixa Verde to the east, and São José do Belmonte and Mirandiba to the west (CPRM, 2005; SEDSDH, 2013).

The Brazilian semi-arid region is characterized by high levels of solar radiation, high temperatures, and a wide space-time variation in rainfall, resulting in water deficiency during seasonal dry spells. The average annual rainfall is 750 mm (Neves; Medeiros; Silveira & Moraes, 2010). The predominant vegetation is caatinga, which is used for agriculture (Mach-

ado & Barros, 1997; Moreira et al, 2006). The soil is typified by red-yellow agrisoil, red-yellow latosoil, luvisoil, and neosoil (EMBRAPA, 1999; Dombroski et al, 2011). In this region, it is common to see dams with high accumulation capacity, which can retain water generated by floods in order to regularize water flows in the dry months of the year. In addition, there are many small reservoirs that are used by the population in the rural area of Pernambuco. In most cases, the only way to meet the water needs of the rural population is with small dams located near communities or alternative technologies like cisterns (Costa & Cirilo, 2010).

Much of the local population suffers from water scarcity. Periodic droughts and resource scarcity, made worse by high population density, produce significant problems requiring innovative solutions. The solution sought by many local governments has been to drill more wells for water, but problems have still arisen with this strategy. Of 213 wells examined in one study, 194 produced saline water (CPRM, 2005). A lack of well monitoring and analysis can exacerbate the unsuitability of these new wells by allowing microbial contamination to go undetected, leading to otherwise preventable diarrheal illnesses (CPRM, 2005). Difficult access to drinking water for this population is not a new phenomenon (Marinho & Candeias, 2007). Sadly, little has been done to address issues of water quality and access. Given the long-standing absence of leadership, the One Million Rural Cisterns Program was created with a fresh perspective to solve these problems.

Economic and Social Characteristics

Livelihood activities of the study area population primarily include agriculture and forestry. Census data from 2010 reflect agriculture and aquaculture sectors as male-dominated. Two-thirds of Serra Talhada's agriculture labor supply are men (IBGE, 2010; Neto et al., 2016).

Serra Talhada is illustrative for the entire region due to its representative commerce, culture, and demographics. The Municipality has the third largest GDP from the Sertão² of Pernambuco, behind those of Petrolândia and Petrolina (Neto et al., 2016).

The population of the Serra Talhada is approximately 86,000 people (IBGE, 2017). About 18,000 of its population are rural inhabitants; 46% are men and 54% are women (IBGE, 2017). Serra Talhada has a Human Development Index³ of 0.682 (Neto et al., 2016). Nearly 15% of the population is classified as extremely poor and the majority of inhabitants makes below a quarter of the national minimum wage (MDA, 2015). Serra Talhada is thus a prominent beneficiary of welfare programs like Bolsa Família (SEDS DH, 2013). The average per capita income of the rural inhabitant is about 620 Reais (approximately 144 euros at time of writing) (IFsertao-pe, 2012). This contrasts with the average GDP per capita of 15,000.00 Reais, or 3,500.00 euros, for the municipality as a whole (IBGE, 2015).

Case Study Objectives and Methodology

The specific objectives of the analysis are:

1. Identify the main contributions of gender and water;
2. Analyze the role of women in water management in the semi-arid region;
3. Identify and analyze social actors and institutions involved in the P1MC;
4. Identify changes in water management in the region as a result of P1MC, on the basis of the opinion of organizations involved and women beneficiaries of the program;

2 Sertão (in Brazil) is a vast region in the hinterlands of Northeast Brazil that is largely covered with Caatinga (Costa et al., 2014).

3 This index ranges from 0 to 1 and reflects three important areas including health, education, and income (UNDP, Ipea and FJP, 2010).

5. Analyze the role of more egalitarian gender relations in responding to the challenges of access to water resources that the semi-arid region imposes.

The study was qualitative in nature, which allowed in-depth appraisal of the program and women's participation. Methods used to collect data included interviews, focus groups discussions, questionnaires, and field observation. These methods supported an analysis of how women's participation in the program has contributed to more sustainable water management in Serra Talhada.

DATA COLLECTION

The data were collected in two field trips between May - July 2016 and May - June 2017. The methodology involved the following four phases:

1. **Interviews:** A total of ten semi-structured interviews were conducted with representatives from a range of key organizations and local and federal governing bodies working with the One Million Cisterns program, known as key informants. Representatives from Women's Secretary⁴ also participated in interviews. These participants were not involved in implementation of the program, but they work closely with women beneficiaries through parallel projects, such as the *Conversa de mulheres no batente* project (Talk with Housewives in English). They were well-informed about specific community characteristics and problems and were cognizant of the relevant water management issues in the region. The purpose of the interviews was to gain background information about these key informants, to identify changes in the commu-

nity's water management after the program, to evaluate how egalitarian gender relations could address challenges of water access, and to identify further questions to be covered in upcoming focus group discussions, as described below. Informants were selected using a snowball sampling recruitment process following recommendations by researchers at the Federal University of Pernambuco who were familiar with the local community. Some interviews were held in person while others were conducted via Skype. All interviews were digitally recorded and lasted between 60 and 90 minutes.

2. **Focus group discussions (FGD):** Seven focus group discussions were held with female household members that benefited from P1MC. Program beneficiaries were selected based on the following criteria:

- Women aged between 15 and 39, single or married, without children;
- Women aged between 15 and 39, married and with children;
- Women aged between 45 and 60, single / divorced / married with children;
- Women aged over 65, married / widowed / divorced, with or without children;

This profile follows the pattern of beneficiaries of the program available in the One Million Cisterns database and was made available for research purposes by a local organization. Each FGD involved four to seven participants, lasted approximately 60 to 90 minutes, and was digitally recorded. Discussions were held in private locations such as participants' homes, or in community centers in five different areas of Serra Talhada (Barra do Exú, Baixio da Carnaúba, Carnaúba do Ajudante, Santana de Caiçarina and Lagoa da Pedra). Local organizations such as the Rural Community Education Center provided assistance in locating women who met the criteria and provided transportation and mediation support.

4 Women's Secretary is the municipal department with the function of coordinating, implementing, and evaluating the Municipal Women's Policy. Its goals are the social promotion of women, elimination of barriers in the labor market, and the end of all forms of discrimination and violence against women. Available at <http://www.serratalhada.pe.gov.br/>

3. Questionnaires: Questionnaires were distributed to the women who participated in the focus group. The purpose was to identify the characteristics of families benefiting from the program, with a focus on the women themselves. The questionnaire explored the sociodemographic characteristics of participants, as well as cistern-specific data, such as distance from the participant's house, volume of water withdrawn, number of water withdrawals (per week) and the person with primary responsibility for water collection and management.

4. Field Observations: Functioning of the program in a real-world context was directly observed by the author. Observations of community behaviors and cistern operations with respect to the daily lives of women were made while living and working with the local community; this approach is considered an effective tool in better understanding the lives of the women of interest (Laurier, 2010). Observation was carried out in the same communities where focus groups and questionnaires were deployed and took place from the point of first contact with communities through to the end of field work. The author utilized both casual and in-depth conversations, and participated in routine community life, such as attending monthly meetings with Women's Secretary representatives and taking part in the local rural association. Photos were taken to document these experiences. Attention was paid to interactions of women and other end users undertaking water management activities, interactions between users and the association or local non-profit organizations, and complaints or feedback provided by users.

Throughout the data collection process, initial notes and subsequent detailed summaries ("memos") of each interview were prepared. All interview data were digitally recorded, transcribed, and checked for accuracy and completeness. Transcripts were uploaded into MAXQDA 12 and thematic analysis was

undertaken to characterize core issues by identifying crucial themes and codes. The final analysis included coding, notes, group discussions, and summary memos. All participants were asked to sign voluntary informed consent prior to participation.

RESULTS

Questionnaire Results

Household characteristics are presented in Table 1.

The data indicate that the ratio of women to men primarily responsible for their household income approaches 1:1. This observation can be explained by the fact that there are many female-headed households, and these women are more often the focus of governmental agricultural policies. Examples of these policies include Pronaf Mulher, which finances women-led agriculture, and Bolsa Família, which conditionally provides welfare to poor families with the aim of increasing school attendance among children and raising preventive health care services participation. Welfare payments in this scheme are provided mainly to the women in individual families. Women are also recipients of rural retirement funds from farming (MDA, 2013; Campelo, 2013; Bianchini, 2015). To place this in context, agriculture remains the principle economic activity, with family farming responsible for over half of Brazil's national production of selected crops (Campelo, 2013).

This study also confirmed a longstanding problem within the semi-arid region, that of female illiteracy. The research findings reflect the array of reasons for which a woman may be illiterate or lack formal education, including the duties of housework, childcare, and the distance between home and school. Women also stated that the number of children for whom they were responsible made it difficult to devote time to schooling.

Table 1. Descriptive Statistics for Household Characterization (n=35) %

Descriptive Statistics for Household Characterization (n=35) %			
Main Responsibility for Household Income	Woman (17) 49%	Man (15) 43%	Both (3) 8%
Economic Activity	Agriculture (18) 51% (Both) Agricultural activity and Governmental program (2) 6%	Rural retirement (8) 23% Other (4) 12% (pension, independent worker, etc.)	Governmental program (3) 8%
Education	Attended formal education (primary school only) (4) 12%	Attended formal education (secondary school) (9) 26%	Did not attend formal education but able to read and write (11) 31% Illiterate (11) 31 %
Housing	Agrarian reform settlements provided by government (22) 63%	Privately owned housing (13) 37%	
Transportation	Motorcycle (8) 23% Truck (2) 6%	Public transport (19) 54% Bicycle (1) 3%	“Carro de linha” (Carro de Linha is a private minivan service providing transportation of people in exchange for money)(3) 8% Others (combination of two, three transports) (2) 6%

Many beneficiaries were living in agrarian reform settlements. Indeed, a third of all families from agrarian reforms in the country are located in Brazil’s northeast (Silveira et al., 2016). Despite the provision of these land parcels, the government still fails to provide basic services such as water, electricity, and other essential commodities (Silveira et al., 2016). Most women mentioned they were users of public transport, but also referred to the poor road infrastructure and inadequate road services that made public transport less reliable.

Findings from Interviews and Focus Groups

According to representatives of the organizations interviewed, P1MC responded to a critical need. Prior to program implementation, communities in the semi-arid region had

lacked a means for convenient and safe water storage. Notably, besides providing the immediate benefit of increased clean water access, the program has promoted values such as participation, citizenship, democracy, and autonomy in the community. At every stage of the program, the ASA proactively included locals, particularly women. Additionally, the program provided other practical benefits like natural resource education and training in financial management and leadership, contributing to their self-sufficiency.

Serra Talhada’s union of rural workers reported an improved and stabilized quality of life directly attributable to the cistern technology. Women were no longer required to walk distances of half an hour to an hour in search of water, trips that were often made more than three times a week. Time saved from water collection afforded women opportunities to

accomplish other duties and improve productivity elsewhere.

Through their participation in associations and the FAST Agroecological Fair⁵, women saw increased roles in water management, according to key informants. They were now able to stand at the forefront of shaping water access, making a noticeable difference to their communities.

As evident from interviews and FGDs, the program empowered women and provided them an opportunity to improve their lives, which encompassed education, income, and health. In the view of organizations involved in P1MC, the approach should be “for women by women,” and for this reason preferentially hired women; 80% of the organizations had equal or majority women participating in their teams.

The Role of Women in Water Management

The unique points of view of women beneficiaries of the program, NGOs, and the government were crucial in highlighting the central role of women in the provision, management and safeguarding of water. Through the interviews, focus groups, and questionnaire results we were able to identify that most of the management of water relies on women and girls.

Women in focus groups explained that, as a result of the program, cisterns became their main water source because of the improved

water quality and access that they provided. As the only available social technology, cisterns were instrumental in lessening the harmful effects of the region’s seven-year dry spell. More traditional sources like water trucks, tanks, and wells fell short, often yielding brackish water unsuitable for most uses. Water from cisterns, however, is a cleaner alternative because organizations provided training to community members for treating the water correctly. Over a two- to three-day period, women were taught about water management, water treatment, and cistern maintenance. In some communities, a health specialist was available to provide further information on the safety of the water following treatment.

Considering time as a resource, cistern technology provided another value by reducing water collection time from over an hour to less than twenty minutes. With the traditional water collection process, women and girls often woke at dawn in order to collect water, which involved searching at length for suitable water sources before carrying supplies home.

Women also described how the program increased participation in local associations where they meet monthly to discuss important issues, as described below:

“We meet to discuss projects, share information, and get updates on project progress. Further, we talk about water-related problems and the agrarian reform settlements. We always talk about issues related to the community. Even if we disagree, we always manage to resolve our issues during the meeting. The meetings are an open space to debate everything that interests the community!” (Ana Patrícia, FGD, Barra do Exú).

These changes brought many opportunities for women, including additional means of generating income and the possibility of progressing to more influential roles in the community. We see examples of this in the

5 FAST Agroecological Fair is the first agroecological fair in Sertão do Pajeú and Central Semiarid of Pernambuco. It was founded in 2000 by a group of male and female farmers from rural communities in the municipalities of Serra Talhada, Santa Cruz da Baixa Verde and Triunfo, who trade in Sérgio Magalhães Square, in the downtown of Serra Talhada. They sell fruits, vegetables, grains, fruit pulp, animal products (poultry eggs, hens, fish, goats, and milk products) and sugarcane liquid free of agrochemicals. Available at: <http://www.cecor.org.br/feiras-agroecologicas.php>

following section.

Program Evaluation

Evaluation of the program considered the resulting changes on women's daily lives, reactions among community members, and areas for improvement. The interviews and FGDs suggest that women felt empowered on water-related issues as a result of the program. Information and skills-building concerning cistern technology and natural resources equipped women with the knowledge to confidently participate in water management.

Considerable time was saved with the cistern technology, allowing women more time to perform other household activities, like housework, childcare, animal feeding, and land maintenance. It is important to note that women spent at least some of this additional time providing benefits to the entire household, which serves as a reminder of the persistent expectations of the roles of women. Equally noteworthy, however, were reports of respondents spending more time on self-care and leisure, including dancing, reading, studying, and attending church activities.

"We felt the change of water in our skin and hair. For example, I washed my hair before and it went hard, nowadays I wash it and I say, wow ... it's great!" (Terezinha, FGD, Carnaúba do Ajudante).

The research also examined men's reactions to a program that included women. Some men were suspicious of P1MC and its objectives, expressing concern over the elevated role given to women, which may in part explain why some organizations experienced difficulty in convincing families to receive a cistern.

"Men were saying: Why is everything for women now?" (Teodora, FGD, Lagoa da Pedra).
"Men can't stand that women are getting

ahead..." (Hermínia, FGD, Barra do Exú).

Despite this initial resistance, most men in the community ultimately accepted the program and even took active roles in assisting with implementation. Opposition towards female involvement was remedied by local associations' efforts, in which meetings were held to discuss water-related problems and the importance of women's participation in the program. The most common words respondents used to describe the work of the local associations were 'support' and 'cooperation'. Organizations also provided incentives, such as food for families and workers, during the time they spent building the cisterns.

"Cisterns were very important for us, but they were something new that we didn't know how to deal with alone, without, for instance, technical guidelines. And the organizations provided very capable people to teach us..." (Ana Patrícia, FGD, Barra do Exú).

The resulting relationships between the community and organizations were thus more productive and these findings demonstrate the potential for communities, NGOs, and the government to work collaboratively in achieving a new way of living in the semi-arid region, while maintaining sustainability and respecting the local biome.

Despite the gains achieved from program implementation, barriers to reliable water access still remain. Insufficient water supplies for community and farming needs, especially during drought seasons, will persist to a degree unless additional solutions are provided. Depending on the community, about 20% still live without cisterns at home. Reasons for this include a reluctance to accept the technology, ignorance of the program's benefits, and failure to fulfill criteria for allocation.

DISCUSSION

We adopted a conceptual model to analyse the role of women in domestic water management and women's participation in the wider community context through a specific water project. The framework shows an adapted model to analyse women's participation in the water sector (Figure 3). Women play a major role in domestic water management in areas where safe water is not immediately available in the house. However, while many water-related duties are assigned to women, most water-related powers and rights are assigned to men as a result of formal and informal structures (Singh, 2008; Mandara, Niehof and Horst, 2017). The framework illustrates the influence of informal structures such as norms, traditions, behaviours and perceptions on the

participation of women in the water sector. Formal structures include policies, guidelines, and legal regulations.

Within the participatory context, each element integrates into the other. In this case, formal structures are an integral part of the water management system and gender equality is a vital principle in formal structures. In the community context, gender equality is at the intersection of water management and informal structures. Participation of women in water management is subject to the influence of informal structures, and here gender is a key underpinning principle. The participatory context and community context influence each other in a complex interface.

The integrative framework helps us see that responsibility for the domestic supply and use

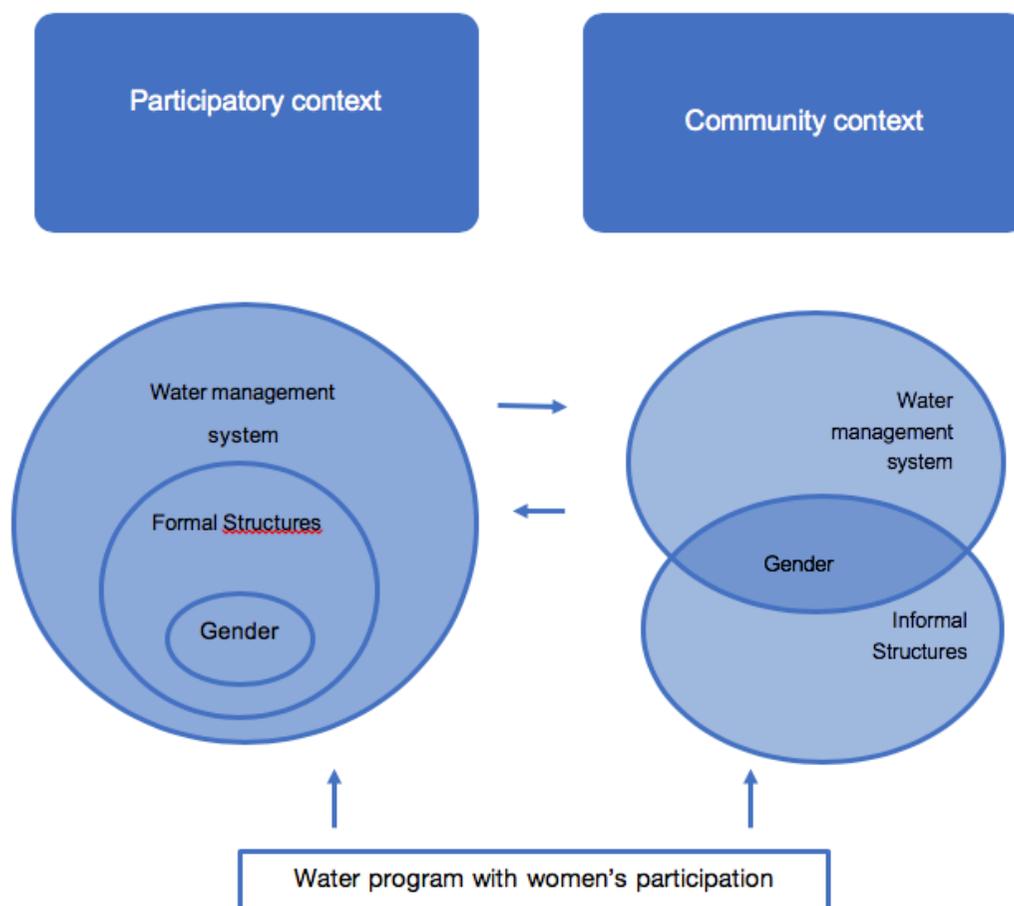


Figure 3. The conceptual framework, Source: Adapted from Singh (2008); Mandara, Niehof and Horst (2017)

of water, through women's knowledge and central role in water management, can contribute to sustainable water management in households and in the wider community.

The program created many opportunities for women. At the household level, women improved their knowledge of water management and gained practical new skills. With the time afforded to them by no longer needing to travel to collect water, women were able to engage in personal leisure activities and other income-generating activities. Younger women and girls also enjoyed more time to study and engage in vocational training.

All individuals interviewed reiterated that solutions to the region's water problems need to involve women. Women's awareness of problems surrounding water and their unique role in its collection were among the reasons put forward for this need; in some respects, women viewed themselves as protagonists in the context of water management. According to one respondent: "A woman fights more for the improvement of water conditions; she is insistent; she is strong and a warrior. In other words, the woman from the semi-arid knows what drought is."

When asked about potential agents who should help to develop solutions to the drought problem, 54% of women answered that it should be a joint effort between citizens and politicians, 26% that it should be the responsibility solely of politicians, and 20% that citizens alone should be responsible. Over the years, rural communities have become increasingly frustrated and even traumatized by dependence on local government and politicians, who often deliver water in exchange for favors, such as votes. Politicians only visited the region prior to elections. For this reason, many community members believe citizens should be included in future efforts to develop solutions to the region's drought problem. Ultimately, however, the government working together with citi-

"A woman fights more for the improvement of water conditions; she is insistent; she is strong and a warrior. In other words, the woman from the semi-arid knows what drought is."

zens, and particularly women, would result in increased transparency and efficiency.

At the community level, women's roles in local associations were elevated and came to be considered essential in solving communal problems. Women were given more opportunities to express their ideas and engage in community-based discussions. By addressing the existing power imbalances between men and women, P1MC represented a critical step towards broader female empowerment.

Despite these positive developments, there are some criticisms to be considered regarding the program's implementation. One such issue stems from the lack of a defined gender strategy compared to other similar organizations. Ideally, this would include a pre-defined, detailed plan for achieving the program's aims with the specific inclusion of a gender perspective, in both the program and in its wider social context. Women's Secretary, for example, runs projects such as the previously mentioned "Conversa de mulheres no batente" and many other targeted programs. Another problem that surfaced during informant interviews was the program's lack of independent funding. The program was heavily dependent on government resources, and as a result, P1MC had two major recesses due to interruptions of government support. The program also failed to create a plan to monitor or follow up on the changes that occurred in the community, especially those that impacted women.

CONCLUSION

This paper has explored the results of fieldwork performed in Serra Talhada, where a water program was implemented and women's participation in local water governance was introduced. This research adds to the body of knowledge on women's participation in water management by analyzing a water program that included women and resulted in female empowerment. P1MC has confirmed the importance of the link between water and gender in policies aimed at sustainable development. Using the Brazilian semi-arid community as its focus, this research observed the persistent exclusion of women from water governance due to prevailing socio-cultural norms, where previous water management arrangements have typically served to reinforce these conditions. Through field observation, we discerned marked changes following the program's implementation in the contribution of women to sustainable development, particularly concerning water management. Women were able to build social capital through local networks rather than through economic resources typically afforded to men. Women were included as primary water users, consumers, and managers; knowledge acquired was then shared among other women, which furthered their empowerment and social capital.

Sorenson, Morssink, and Campos (2011) illustrate the communal benefits of expanding participation of women in planning and decision-making. The equal participation of women in decision-making processes is a prerequisite for more egalitarian access to water and could lead to services that respond more effectively to the different needs and interests of all members of the community, men and women alike (FAO, 2012; Mandara, Niehof and Van der Horst, 2017). In the semi-arid region, this could represent a step towards solving many water-related problems.

We observed resistance towards the disruption of prevailing gender dynamics, not only in families, but in communities, institutions, and organizations. We identified factors which may contribute to this, including the deeply-rooted sociocultural norms contributing to problematic gender roles. The identification of these factors in this study will be vital to addressing them in future programs in the region. The need for action in this area is obvious and will act as a focus for the reintroduction of gender mainstreaming. P1MC represents a first step towards equality in the region, but it will require NGOs and those who campaign for women's causes to support rural women and encourage effective female participation. Nevertheless, the process of social inclusion of women in water management, as a primary objective of this program, seems to have been effective. More egalitarian gender relations should help address the challenges of water access in the semi-arid region, since equality helps to ensure the effectiveness of sustainable development strategies.

REFERENCES

- Aladuwaka, Seela, and Janet Momsen. 2010. "Sustainable Development, Water Resources Management and Women's Empowerment: The Wanaraniya Water Project in Sri Lanka." *Gender & Development* 18 (1): 43-58.
- AP1MC. 2012. "Declaração sobre o atual momento da seca no Semiárido". ASA. 1-8.
- Arubayi, O, and Diana O Arubayi. 2016. "Beyond the MDGs: inclusion, participation and the reality of gender development in sub-Saharan Africa (ssa)." *International Journal of Development Research* 6: 7228-34.
- Baguma, D et al. 2013. "Safe-water shortages, gender perspectives, and related challenges in developing countries: the case of Uganda". *The Science of the Total Environment*, 442, 96-102.
- Barlow, Maude. 2007. "Blue covenant: The global water crisis and the coming battle for the right to water". New York, NY: New Press.
- Bennett, Vivienne, Sonia e Dávila-poblete, and María Nieves Rico. 2008. "Water and Gender: The Unexpected

Connection That Really Matters." *Journal of International Affairs* 61 (2): 107–26.

Bianchini, V. 2015. *Vinte Anos Do Pronaf, 1995-2015: Avanços E Desafios*. MDA.

Boateng, Jillette D, Borwn, CK & Tenkorang, E. Y. 2013. "Gender and Water Management Practices in Ghana". *Journal of Environment and Earth Science*, 3(5).

Bonifácio, Sávio Nunes. 2011. "A Percepção Dos Beneficiários Do p1mc Quanto À Utilização Das Cisternas de Água de Chuva No Semiárido Mineiro." Universidade Federal de Minas Gerais.

Branco, Adélia de Melo. 2000. "Mulheres da seca: luta e visibilidade numa situação de desastre". João Pessoa: UFPB: Ed. Universitária, 2000. 1-220.

Brito, et al. 2012. "Água de chuva armazenada em cisterna produz frutas e hortaliças para o consumo pelas famílias rurais: estudo de caso 1". In *Simpósio Brasileiro de captação e manejo de água de chuva*, 1-6.

Campelo, Daniel Alves. 2013. "As Políticas Públicas Para a Agricultura Familiar Brasileira Em Clima Semiárido: Do Combate À Convivência." *RBPG* 10 (21): 851–73.

Carrard, N., Crawford, J., Halcrow, G., Rowland, C., & Willetts, J. 2013. A framework for exploring gender equality outcomes from WASH programmes. *Waterlines*, 32(4), 315-333.

Cirilo, José Almir. 2008. "Políticas públicas de recursos hídricos para o semi-árido". *Estudos Avançados*, 22(63), 61–82.

CGU- Controladoria geral da União. 2011. "Relatório de avaliação da execução de Programas de governo nº 3. construção de cisternas para armazenamento de água". União. http://www.cgu.gov.br/sobre/institucional/eventos/anos-anteriores/2016/ii-seminario-de-auditoria-interna-governamental/arquivos/21_11-aepg-programa-agua-para-todos.pdf (Accessed May 5, 2016).

Cordeiro, R. D. L. M., Silveira, S. M. B., Morales, P., & Almeida, V. 2012. Mulheres e água: a experiência da rede de mulheres rurais da América Latina e do Caribe. *Revista AntHropológicas-ISSN: 2525-5223*, 23(1).

Costa, Margarida Regueira da Costa e Cirilo, José Almir. 2010. "Análise do potencial de uso das águas subterrâneas nas bacias da região semiárida de Pernambuco". In: XVI Congresso Brasileiro de Águas Subterrâneas e XVII Encontro Nacional de Perfuradores de Poços.

Costa et al. 2014. O Homem e a Mulher Da Caatinga: Aspectos Históricos e Culturais. In *Conceitos*, ed. Ricardo da Silva Lucena, Ricardo de Figueiredo e Araújo. , 53–60.

Das, Priyam. 2014. "Women's Participation in Community-Level Water Governance in Urban India: The Gap Between Motivation and Ability." *World Development* 64 (December): 206–18.

Dias, Rafael De Brito. 2013. "Tecnologia Social E Desenvolvimento Local : Reflexões a Partir Da Análise Do Programa Um Milhão de Cisternas" 1 (2): 173–89.

Duque, Ghislaine. 2008. "Conviver Com a Seca: Contribuição Da Articulação Do Semi-Árido/ASA Para O Desenvolvimento Sustentável." *Desenvolvimento E Meio Ambiente*.

Dombroski, J. L. D., et al. 2011. "Water relations of Caatinga trees in the dry season". *South African Journal of Botany*, 77(2), 430–434.

Elmhirst, R., & Resurreccion, B. 2008. "Gender, environment and natural resource management: New dimensions, new debates". *Gender and Natural Resource Management: Livelihoods, Mobility and Interventions*.

EMBRAPA. 1999. Centro Nacional de Pesquisa de Solos. "Sistema brasileiro de Classificação de Solos". Embrapa Solos, 412p.

EMBRAPA. 2014. Mapas. <https://www.embrapa.br> (Accessed 5 March, 2015).

Esquivel, V. 2016. "Power and the Sustainable Development Goals a feminist analysis". *Gender & Development*, 24(1), 9–23.

FAO. 2012. "Passport to Mainstreaming Gender in Water Programmes". Publishing Policy and Support Branch Office of Knowledge Exchange, Research and Extension FAO. 68p.

Figueiredo, P., & Perkins, P. E. 2013. "Women and water management in times of climate change: participatory and inclusive processes". *Journal of Cleaner Production*, 60, 188–194.

Fundação do Banco do Brasil. 2014. "Cisterna de Placa. Tecnologia social com política pública para o semiárido Brasileiro." organização Jeter Gomes.1 ed.Brasília.

Grant, M., Huggett, C., Willetts, J. 2016. "Gender & SDG 6: The Critical Connection A Framing Paper for the high-level panel on water". The Australian water partnership.1-12.

Gomes, Uende Aparecida figueiredo and Pena, J. L. 2012. "Confrontando a vulnerabilidade e indefensabilidade social: a experiência da articulação no semiárido brasileiro (ASA)". *GEOUSP- Espaço e Tempo*, 31(Especial), 45–56.

Gomes, U. A. F et al. 2014. "Subsidizing the sustainability of rural water supply: the experience of the Brazilian rural rainwater-harvesting programme". *Water International*, 39(5), 606–619.

- Gutiérrez, A. P. A., Engle, N. L., De Nys, E., Molejón, C., & Martins, E. S. 2014. Drought preparedness in Brazil. *Weather and Climate Extremes*, 3, 95-106.
- Hall, R., Ranganathan, S., & Kumar, Raj G C. 2017. "A General Micro-Level Modeling Approach to Analyzing Interconnected SDGs: Achieving SDG 6 and More through Multiple-Use Water Services (MUS)". *Sustainability*, 9(3), 314.
- Harris, L. M., & Gantt, W. 2007. "Gender and shifting water governance: Differential effects of privatization, commodification and Democratization". *Tenure Brief no6*. University of Wisconsin-Madison, 1-9.
- IBGE- Instituto brasileiro de Geografia e Estatística. 2010. "Base de informações municipais". Censo Demográfico 2010. Disponível em: <<http://www.censo2010.ibge.gov.br>>.
- IBGE- Instituto Brasileiro de Geografia e Estatística. 2016. "IBGE Cidades- Serra Talhada". <https://cidades.ibge.gov.br/brasil/pe/serra-talhada>. (Accessed June, 20 2016).
- IBGE- Instituto Brasileiro de Geografia e Estatística. 2017. "IBGE Cidades- Serra Talhada". <https://cidades.ibge.gov.br/brasil/pe/serra-talhada>. (Accessed August, 20 2018).
- IFsertao-PE- Instituto Federal de Educação, Ciência e Tecnologia- Sertão Pernambucano. 2012. Observatório Econômico - Serra Talhada. Prodi. 1-39p.
- Kevany, Kathleen. 2010. "Water, Women, Waste, Wisdom, and Wealth – An Energizing International Collaboration, Action Research, and Education Project." *Journal of Cleaner Production* 18 (16-17): 1769-71.
- Laurie, Nina. 2011. "Gender Water Networks: Femininity and Masculinity in Water Politics in Bolivia" 35 (January): 172-88.
- Laurier, E. 2010. "Participant Observation". in N Clifford, S French & G Valentine (eds), *Key Methods in Geography*. 2nd edn, SAGE Publications Ltd, London, pp. 116-130.
- Leite, Marianna. 2010. "After the Summit: Women's Access to Water and Policymaking in Brazil." *Gender & Development* 18 (1): 69-79.
- Machado, I.C.S.; Barros, L.M. 1997. "Phenology of Caatinga species at Serra Talhada, PE, Northeastern Brazil". *Biotropica*, Washington, v.29, n.1: 57-68.
- Mandara, CG; Niehof, A; Horst, H. 2017. "Women and Rural Water Management: Token Representatives or Paving the Way to Power?" *Water Alternatives*, 10(1), 116-133.
- Marengo, J. A. 2008. "Vulnerabilidade, impactos e adaptação à mudança do clima no semi-árido do Brasil". *Parcerias Estratégicas*, 1(5), 149-174.
- Marinho, José Rosemário Galindo & Candeias, A. L. B. 2007. Gerenciamento de distribuição de água no semi-árido. In In: II simpósio Brasileiro de Geomática V colóquio Brasileiro de Ciência Geodésicas. 24-27.
- Ministério Das Cidades. 2016. Gasto público em Saneamento Básico – 2014. Brasília, Secretaria Nacional de Saneamento Ambiental – SNSA.
- Ministério Do Desenvolvimento Agrário – Mda. 2013. Plano Safra Semiárido 2013-2014. Brasília, 2013. Disponível em: http://www.mda.gov.br/sitemda/sites/sitemda/files/ceazinepdf/cartilha_plano_safra_semiarido_baixa.pdf Acesso em: 10 Outubro. 2015.
- Moreira, J. N. et al. 2006. "Caracterização da vegetação de Caatinga e da dieta de novilhos no Sertão de Pernambuco". *Pesquisa Agropecuária Brasileira*, 41(11), 1643-1651.
- Moraes, A. & Perkins, P. E. 2007. "Women, Equity and Participatory Water Management in Brazil". *International Feminist Journal of Politics*, 9(4), 485-493.
- Moraes, A. F. J. De & Rocha, C. 2013. "Gendered waters: the participation of women in the "One Million Cisterns" rainwater harvesting program in the Brazilian Semi-Arid region". *Journal of Cleaner Production*, 60, 163-169.
- Nascimento, Flávia M. F. 2005. "Histórico das Secas e Programas do Governo no semi-árido: 1534-2004". *Série Estudos e Documentos*. CETEM. Rio de Janeiro.
- Neves, R. S.; Medeiros, J. C. D. A.; Silveira, S. M. B & Morais, C. M.M. Programa Um Milhão De Cisternas: Guardando Água Para Semear Vida. *Revista Agriculturas: Experiências Em Agroecologia*, p.7-11, 2010.
- Oliveira, Maria do perpétuo socorro Godoy inácio de & Sobral, Maria do carmo Martins. 2012. Gestão ambiental no sertão do Pajéu- no município de Serra Talhada- pernambuco. *Revista dos mestrados profissionais*, volume 1, número 1.
- O'Reilly, K. 2010. Combining sanitation and women's participation in water supply: an example from Rajasthan. *Development in Practice*, 20(1), 45-56.
- Oyanedel-Craver, V., Cotel, A., Saito, L., Abu-Dalo, M., Gough, H., & Verstraeten, I. 2017. Women-Water Nexus for Sustainable Global Water Resources. *Journal Water resour.Plann.Manage.*, 143(8), 1-2.
- Passador, Claudia souza; Passador, João Luiz .2010. "Apontamentos sobre políticas públicas de combate à seca no Brasil: Cisternas e cidadania?" *Cadernos Gestão Pública e Cidadania*, v. 15, n. 56, São Paulo, 65-86.
- Pérez-Marin et al. 2017. "Agroecological and Social Trans-

- formations for Coexistence with Semi-Aridity in Brazil." *Sustainability (Switzerland)* 9(6): 1–17.
- Pontes, Emilio Tarlis Mendes and Machado, T. A. 2009. "Desenvolvimento sustentável e convivência com o semi-árido: o caso do programa um milhão de cisternas rurais no nordeste brasileiro". In *XIX Encontro Nacional de Geografia Agrária*. (pp. 1–23).
- Pontes, E. T. 2013. "A Estreita Relação entre Mulher e Água no Semiárido: o Caso do Programa um Milhão de Cisternas Rurais". *Revista Latino-Americana de Geografia E Gênero*, 4(1), 14–21.
- Rautanen, S.-L., & Baaniya, U. 2008. Technical work of women in Nepal's rural water supply and sanitation. *Water International*, 33(2), 202–213.
- Ray, Isha. 2007. "Women, water and development". *Annu. Rev. Environ. Resour.*, 32, 421–449.
- Sachs, J. D. 2012. "From millennium development goals to sustainable development goals". *The Lancet*, 379(9832), 2206–2211.
- SEDSDH- Secretaria de Desenvolvimento Social e Direitos Humanos. 2013. Monitoramento da assistência social - relatório municipal de Serra Talhada.
- Silva, R. M. A. 2003. Entre dois paradigmas: combate à seca e convivência com o semi-árido. *Sociedade e Estado*, 18(n.1/2), 2003. 361–385p.
- Silveira et al. 2016. "Public policies for rural development and combating poverty in rural areas". *International Policy Centre for Inclusive Growth (IPC-IG) and United Nations Development Programme*, 1–60.
- Singh, N et al. 2003. "Women and water: a policy assessment". *Water Policy*, 5, 289–304.
- Singh, N. 2006. "Women's s Participation in Local Water Governance: Understanding Institutional Contradictions". *Gender, Technology and Development*, 10(1), 61–76.
- Singh, N. 2008. "Equitable Gender Participation in Local Water Governance: An Insight into Institutional Paradoxes". *Water Resources Management*, 22(7), 925–942.
- Singh, N et al. 2008. "Gender and Water from A Human Rights Perspective: The Role Of Context In Translating International Norms Into Local Action", *Rural Society*, 18:3, 185-193.
- Sorenson, S. B., Morssink, C., & Campos, P. A. 2011. "Safe access to safe water in low income countries: water fetching in current times". *Social Science & Medicine* (1982), 72(9), 1522–6.
- Souza, Sara Fernandes; Araújo, Maria do socorro Bezerra de; Galvêncio, J. D. 2007. "Mudanças do uso da terra no município de serra talhada-Pe utilizando análise por componentes (ACP)". *Revista de Geografia. Recife: UFPE- DCG/ NAPA*, 24(3), 85–100.
- Tcu- Tribunal De Contas Da União. 2006. Relatório de avaliação de programa: Ação Construção de Cisternas para Armazenamento de Água. Relator Ministro Guilherme 18 Palmeira. Brasília: TCU, Secretaria de Fiscalização e Avaliação de Programas de Governo.
- Tibesigwa, B; Visser, M; Hunter, L; Collinson, M & Twine, W. 2015. "Gender Differences in Climate Change Risk, Food Security and Adaptation: A Study of Rural Households' Reliance on Agriculture and Natural Resources to Sustain Livelihoods". 32.
- UNDP, IPEA and FJP. 2010. Atlas do Desenvolvimento Humano no Brasil. <http://atlasbrasil.org.br/2013/pt/download/> (Accessed July 7, 2016).
- Wallace, Tina and Coles, Anne. 2005. "Water, gender and development: an introduction". In: Coles, Anne, Wallace, Tina (Eds.), *Gender, Water and Development*. Berg Publishers, Oxford, UK.
- Wallace, T., & Porter, F. 2010. "Introduction gender and development". *Gender & Development*, 18(1), 1–10.
- WHO and UNICEF -World Health Organization/United Nations Children's Fund. 2014. Progress on drinking water and sanitation: 2014 Update. New York, WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation.
- WHO and UNICEF -World Health Organization/United Nations Children's Fund. 2015. WHO/UNICEF. 2015 Update and MDG Assessment. World Health Organization, 90.
- Yerian, S., Hennink, M., Greene, L. E., Kiptugen, D., Buri, J., & Freeman, M. C. 2014. "The role of women in water management and conflict resolution in Marsabit, Kenya". *Environmental Management*, 54(6), 1320–30.