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LINKING WATER ACCESS AND EDUCATION IN THE SUSTAINABLE DEVELOPMENT GOALS IN SUB-SAHARAN AFRICA

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ABSTRACT

Despite the growing literature on water access, little is known about the effect of water access on education, particularly in sub-Saharan African countries. The aim of this paper is to fill this gap by assessing how water access affects education in 23 sub-Saharan African countries over the period 2000-2018. To carry out our investigation, we used the Generalized Moments Methods (GMM). The results show that there is a negative relationship between water access and education. Furthermore, parliament women and government effectiveness play an important role in mitigating the negative impact of water access on education. Finally, the positive association between water access and education in sub-Saharan Africa is conditioned by the achievement of a certain threshold of parliament women and government effectiveness.

Contribution/Originality: Despite the important literature on the relationship between access to drinking water and education, no macroeconomic study has yet highlighted the relationship between the two variables. This limitation of the literature constitutes the main contribution of this article. Subsidiarily, this article analyzes the contribution of parliament women in the transmission of the effects of access to water on education.

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1. INTRODUCTION

Education is an economic good because it is not easy to obtain and therefore must be distributed. It is seen as both a consumer and a capital good, as it provides utility (satisfaction) to the consumer and also serves as an input to develop the human resources necessary for economic and social transformation. The human capital theory is based on the assumption that formal education is necessary to improve the productive capacity of a population.

Despite the progress made by the Millennium Development Goals (MDGs) in 2015, the number of out-of-school children of primary school age worldwide is 57 million (United Nations, 2015). It is for this reason that ensuring quality education for all and at all ages is one of the overarching objectives, set at the heart of the 2030 Agenda of Sustainable Development Goals (SDGs). Education is one of the basic needs for human development and a contribution to poverty reduction (Sivakumar & Sarvalingam, 2010). It is necessary for national development and a prosperous society.

Human capital theorists (Becker, 1962; Lucas, 1990; Mincer, 1958) argued that an educated population is a productive population. Improving the level of education of the population is an important condition for fostering the development of a country. It is therefore imperative to understand the factors that affect the level of education. The particular choice of the countries of sub-Saharan Africa is justified by the fact that, among the regions of the world, sub-Saharan Africa has the highest rates of exclusion in education. In fact, more than a fifth of children aged around 6 to 11 are out of school, followed by a third of children aged around 12 to 14 and almost 60% of young people aged around 15 to 17 are out of school (Institute of Statistics for UNESCO, 2019). In general, the African continent remains a first student when it comes to school exclusion. With a 21% exclusion rate, sub-Saharan Africa has a higher rate than North Africa (11%) (Institute of Statistics for UNESCO, 2019).

Like education, the right of access to clean, fresh water is a fundamental human right (Samra & Fawzi, 2011).

Water quality is a fundamental nutrient for life (Bonfante et al., 1999). And since there is no provision for water storage in the body, all water loss over a period in an individual must be replaced. The thirst signal is not triggered until the body mass loss of 1-2% has been achieved and the kidneys have already started to concentrate urine. While a decrease of less than 10-20% in body weight is unlikely to be fatal, dehydration does have short- and long-term consequences.

In addition to its nutritional role, it plays an essential role in supporting economic development. However, its quality and quantity are determining factors that influence its function for the environment, economy and social needs (Garcia, 1998; Young, Dooge, & Rodda, 1994). According to Biswas (2004), water problems affect several development sectors such as agriculture, industry, environment, health and education.

When the MDGs expired in 2015, only a few countries in Africa had succeeded in halving the proportion of people without access to safe drinking water, and none had been able to meet the goal of sanitation (UNICEF and WHO, 2015). The WHO / UNICEF Joint Monitoring Program for Water Supply and Sanitation estimates that 32% of the population of sub-Saharan Africa, or about 319 million people, do not have access to an improved drinking water source, while 70% or about 695 million people did not have access to sanitation. With the adoption of the Sustainable Development Goals (SDGs) in 2015, the African continent places great hope in the achievement of Goal 6 - ensure access to water and sanitation for all by 2030.

Despite this progress, in 2017, 29% of the world's population still did not have access to safe drinking water and about 55% did not have access to sanitation (UNICEF & WHO, 2019). In sub-Saharan Africa, where the situation remains the most worrying, 39% of the population does not have access to a source of drinking water, compared to 69% who do not have access to improved sanitation (UNICEF & WHO, 2019). In this part of the world, significant disparities between rural and urban areas persist, with only 45% of the rural population having access to safe drinking water, compared to 84% of the urban population. Likewise, only 22% of the rural population has access to improved sanitation, compared to 44% of the urban population (UNICEF & WHO, 2019).

Unequal access to water and sanitation can translate into inequalities in health and education. When not connected to the water and sewer system, household members, especially children, may be at greater risk of contagion from water-related and water-borne diseases that prevent them go to school and be successful in their studies. Children may end up spending more time collecting, transporting and storing water and sewage than going to school or preparing homework. Water shortages and poor functioning water and sewerage systems can reduce the efficiency of education and health spending by all levels of government. However, most rural areas in developing countries do not have an improved water supply and the impact has worsened further due to high population growth (United Nations, 2010).

In rural areas of poor countries, water supply is more of a physical labor to obtain water or to draw water from a well and carry it a considerable distance from sources. In addition, it consumes a significant part of the time (Cherutich, Timothy, & Quinter, 2015). When water is not available on household premises, distance to the water source becomes a critical variable for children's health and development. A shorter distance to the water source is associated with a lower incidence of diarrhea, fever and cough, lower infant mortality, and better height and weight-for-age scores (Pickering & Davis, 2012; Rakodi, 1999).

In contrast, households may have more time available to engage in income-generating activities with better access to water and sanitation services (Range, Griesinger, Dachs, Bittner, & Tavares, 2002). Better access to water not only increases household labor productivity through health gains, but it also leads to a reduction in communicable diseases within communities. In many societies, women and girls take care of household chores and water collection, transport, storage and handling. Breaking the cycle of poverty for women, through access to water, can translate into better outcomes for their children. Women's work increases their financial independence and bargaining power within the household, which improves the well-being of children (Van & Gayatri, 2010).

The sexual division of labor influences access and control over water resources. Since women are responsible for household water collection in developing countries, some of them spend up to 25% of their productive time fetching water (Sullivan, 2001). In fact, a study by Nigam, McCallum, Thrun, and Mitchell (1998) on a watershed in South Asia showed that women and girls withdraw twice the amount of water per year than men and boys. Thus, the time women spend fetching water affects the time available to them for paid work and education.

These differences in water use and access are explained by divergent social positions between men and women in developing countries (Crow & Farhana, 2002). In these countries, women have the primary responsibility for performing household chores, including collecting water (Elson, 1995). Indeed, in non-industrialized countries, men control land, finances, industry and government, and therefore, they tend to control access to water.

In water management practice, water-using communities tend to be predominantly female, while decision-making communities tend to be predominantly male (Cleaver & Elson, 1995; Zwarteveen & Meinzen-Dick, 2001). Even when water user associations are established to give all users a role in governance, other more powerful governance institutions may continue to dictate water use and control water supply (Cleaver & Elson, 1995).

Access to water and sanitation services impacts academic performance at school in two different ways. First, water-related diseases are transmitted through the following routes: water-borne diseases (such as cholera and typhoid), water-related diseases (eg trachoma), water-borne diseases water and vector-borne infections (such as malaria, filariasis and dengue) and water-borne infections (such as legionellosis) (Hutton, 2012). Thus, better water and sanitation services help households save on health care and improve productivity. Second, studies have shown that dehydration can impair cognitive discrimination and short run memory (Khanna, 2008). As a result, lack of water adversely affects academic performance by reducing their cognitive abilities.

Empirically, work on the relationship between access to water and education is almost non-existent. Based on a case study in a poor rural district in India, James et al. (2002) found that when improvements in water access are linked to opportunities for microenterprises, time spent collecting water is converted into earned income. In areas where women and girls are responsible for collecting water, these results suggest that, i) "better access to water" would influence the participation of women and girls in daily activities, ii) time spent collecting water would increase women's wages through increased non-market production and, iii) time spent collecting water for girls would result in higher levels of education. Santiago Ortiz-Correa, Resende Filho, and Dinar (2016) analyzed the effect of access to water and sanitation on education in some municipalities in Brazil. Using an instrumental approach, the authors found that access to water and sanitation services has a positive and significant effect on schooling, when measured by the number of school years completed. These positive effects call for the expansion of lagging sewage systems across the country, both at home and at school. Demie, Bekele, and Seyoum (2016) follows suit and analyzes the impact of accessibility to water on girls' and women's participation in education and other activities in Wuchale and Jidda Woreda (Ethiopia). The study is carried out on a sample of 197 households. The following results emerge from this study: i) An individual obtains water by walking an average distance of 2.78 ± 0.81 km from their residential area, which is above the maximum distance standard (1 km) set by the WHO and the UNICEF; ii) the study also showed that about 5.23 ± 2.82 hours per day were spent by girls and women fetching water. Even after traveling long distances and spending many hours a day, the water they get lacks sanitation and hygiene as they use it together with livestock and other living things; iii) Poor access to drinking water coupled with illiteracy (73.1%) and the prevalence of water-borne diseases strongly influenced the participation of girls and women in education, agricultural production and other development activities in the study area. This was in line with the conclusions of Cherutich et al. (2015) who asserts that the opportunity cost of collecting water has social and economic dimensions. They further emphasized this point because, when the burden of water collection falls disproportionately on women and children, it has a cumulative effect on children's education, health and safety, including the erosion of their emotional well-being.

Although scarce, work on the relationship between access to drinking water and education is reduced to microeconomic analyzes. No macroeconomic study has yet been conducted on the relationship between the two variables.This study aims to fill this gap in the literature by analyzing the effect of access to water on education in sub-Saharan Africa where the exclusion rate in education is the highest among all regions of the world. Indeed, easy access to drinking water should not only reduce the time spent by children per day to fetch drinking water but improve their school performance through more time devoted to studies.

But in view of the high school exclusion rate in SSA, this calls on us to take a look at the relationship between access to water and education in this region. In addition, given the fact that water collection is mainly the responsibility of girls and women, they would be in a better position to master the various constraints related to access to water. To this end, can a significant increase in women's access to power bodies (in parliament, for example) play a role in the transmission of the effects of access to water on education?

The rest of the paper is organized as follows. Section 2 describes the data and methodology used to capture the link between water access and education. Section 3 discusses our empirical results, while section 4 concludes.

2. DATA AND METHODOLOGY

2.1. Data

We study a panel of 23 countries in sub-Saharan Africa with data for the period 2000-2018 from the World Development Indicators (WDI). The periodicity and the countries studied are chosen according to the constraints of data availability.

The dependent variable in this study is education. This variable is measured in this work through three indicators: the primary enrollment rate, the secondary enrollment rate and the tertiary level enrollment rate. These variables have already been used in the literature by authors such as Goldin and Katz (1997); Federman and Levine (2005) and Le Brun, Helper, and Levine (2011). The main independent variable in this study is access to drinking water. This variable is measured as the percentage of the population with access to safe drinking water in a given country.

A set of macroeconomic variables considered as determinants of education are used as control variables. These variables are largely based on the related education literature. These are access to sanitation, agriculture, population growth, manufacturing. The sources, the definitions of the variables and the list of countries in our panel are summarized in the appendix (cf. Table A1 and Table A2).

Table 1 gives the summary statistics of the variables and Table 2 provides the results of the cross-dependency test of Pesaran (2004). Table 2 shows that all the variables admit a transverse dependence with regard to their probability which is zero. Finally, Table 3 shows the results of the stationarity test of Pesaran (2007). It emerges from this table that all the variables are stationary at level. A brief description of the expected signs is given below.

According to Santiago Ortiz-Correa et al. (2016), access to safe drinking water has a positive effect on education. Like access to water, access to sanitation also positively impacts education Santiago Ortiz-Correa et al. (2016). As for the relationship between agriculture and education, Engler and Kretzer (2014) found that there is a positive relationship between the two variables. Likewise, Bilsborrow (1978) argue that there is no relationship between population growth and education. According to Le Brun et al. (2011), manufacturing work has a negative effect on education.

Table-1. Descriptive statistic

Variables	Obs	Mean	Median	Std Dev	Min	Max
Manuf	437	9.51	9.20	4.42	0.23	21.21
Agriculture	437	23.79	23.98	12.67	2.08	58.65
Popgr	437	2.74	2.76	0.64	0.23	4.62
Water	437	55.01	54.31	13.84	19.89	92.27
Sanitation	437	25.71	22.69	14.26	4.32	74.82
Goveff	437	-0.84	-0.83	0.45	-1.74	0.69
Polist	437	-0.79	-0.66	0.78	-2.66	0.66
Woparl	437	17.62	13.88	10.91	1.2	44.5
Peducation	437	96.14	99.34	22.82	32.35	149.30
Seducation	437	36.05	33.84	18.28	6.19	109.44
Teducation	437	5.93	4.64	4.52	0.34	20.48

Table-2. Pesaran (2004).

Variables	CD-Test	P-Value	Corr	Abs (corr)
Peducation	22.14	0.000	0.319	0.609
Seducation	52.32	0.000	0.755	0.909
Teducation	51.08	0.000	0.737	0.797
Woparl	22.80	0.000	0.32	0.619
Manufact	8.49	0.000	0.122	0.423
Agriculture	5.08	0.000	0.073	0.381
Popgr	4.15	0.000	0.060	0.532
Water	28.49	0.000	0.411	0.959
Sanitation	20.73	0.000	0.299	0.971
Goveff	5.04	0.000	0.073	0.414

Table-3. Pesaran stationarity test.

Variables	CIPS*	CV (10%)	CV (5%)	CV (1%)	Decision
Peducation	-2.18**	-2.07	-2.15	-2.32	I(0)
Seducation	-2.22**	-2.07	-2.15	-2.32	I(0)
Teducation	-2.43***	-2.07	-2.15	-2.32	I(0)
Water	-2.56***	-2.07	-2.15	-2.32	I(0)
Sanitation	-2.89***	-2.07	-2.15	-2.32	I(0)
Manuf	-2.387***	-2.07	-2.15	-2.32	I(0)
Popgr	-3.199***	-2.07	-2.15	-2.32	I(0)
Goveff	-2.12*	-2.07	-2.15	-2.32	I(0)
Agriculture	-2.367***	-2.07	-2.15	-2.32	I(0)
Woparl	-2.138*	-2.07	-2.15	-2.32	I(0)

Note: ***, **, *: represent the significance thresholds at 1%, 5% and 10% respectively.

2.2. Methodology

The aim of this paper is to investigate the impact of water access on education in sub-Saharan African countries. According to the recent literature on education (Santiago Ortiz-Correa et al., 2016), we formulate the following model:

$$Education_{it} = \beta_0 + \beta_1 Educaction_{it-1} + \beta_2 Water_{it} + \beta_3 X_{it} + \mu_i + v_t + \varepsilon_{it} \quad (1)$$

Where $Water_{it}$, represents people using at least basic drinking water services (% of population) for country i in the period t, $Education_{it}$ is the level of education for country i in the period t, X_{it} is a vector which includes all control variables, μ_i is an unobserved country-specific effect, v_t is time specific effect, and ε_{it} is the error term.

This study uses the estimation methodology of the GMM system. Several reasons justify the use of this method. According to Roodman (2009), the necessary condition for the application of the GMM methodology is that the number of cross sections is greater than the time dimension. This is exactly the nature of our data since we are arranged over 23 countries and over 19 years. Also, the inclusion of the lagged dependent variable in our model could lead to a correlation with the fixed effect in the error term (Nickell, 1981) raising the problem of endogeneity. The GMM estimator has been widely used to solve the endogeneity problem that appears in the estimation of panel data (Arellano & Bond, 1991; Arellano & Bover, 1995; Blundell & Bond, 1998). In addition, this estimator also takes into account the biases that appear due to country-specific effects and it also avoids the problems of simultaneity or reverse causality. The consistency of the GMM estimator depends on two tests: the validity of the assumption that the error term has no serial correlation (AR (2)) and the validity of the instrument (Hansen test). Too many instruments can seriously weaken and bias Hansen's overidentification restriction test, and therefore the rule of thumb is that the number of instruments should be less than the number of countries (Roodman, 2009).

3. RESULTS

The results are presented in the various tables below. Table 4 presents the results of the impact of access to water on education through the GMM method. Table 5 reproduces the model presented in Table IV by introducing the transmission channels. The estimation regressions mutually satisfy the Hansen instrument validity test and the AR (2) serial correlation test.

Analysis of Table 4 shows that water access has a negative and significant effect on education. Thus, an increase in access to drinking water for a unit leads to a reduction in the enrollment rate of 13.8%; 2.9% and 0.7% respectively for primary, secondary and tertiary education (column 1-3). This result is contrary to the work of Santiago Ortiz-Correa et al. (2016) who found that access to water has a positive impact on education in Brazil. According to statistics from the joint (UNICEF and WHO, 2015) monitoring program for water supply and sanitation, it is estimated that 32% of the population of sub-Saharan Africa, or about 319 million people, do not have access to an improved drinking water source (Ndikumana & Pickbourn, 2017). And in this region, school children are responsible for fetching water. As a result, an insufficient supply of water increases the time it takes for learners to collect water. Thus, a limited supply of water increases the likelihood that learners will drop out of school in search of drinking water.

Agricultural value added has a negative and significant effect on education. Thus, an increase in this value by 1% leads to a reduction in the registration rate of 0.8%; 2.4% and 0.7% respectively for primary, secondary and tertiary education (column 1-3). This result is contrary to the work of Engler and Kretzer (2014) who found a positive effect of agriculture on education. This result can be explained by the fact that for financial reasons, some young people were forced to drop out of school to concentrate on agricultural activities in order to support their families. This is generally the case in rural areas where agricultural activities are more prosperous compared to urban areas.

As for the population, it has a negative and significant effect on education. Thus, a population increase of 1% leads to a decrease in the enrollment rate of 1.8%; 0.62% and 0.42% respectively for primary, secondary and tertiary education (column 1-3). This result is contrary to that of Bilsborrow (1978) who found no link between the two variables. This result can be explained by the fact that population growth is faster in Africa compared to other regions of the world and therefore exceeds the construction of educational infrastructure, thus leading to overcrowding of schools which constitutes an obstacle to the quality of teaching and sometimes in unsanitary conditions not conducive to learning.

Regarding manufacturing value added, it has a negative and significant effect on education. Thus, an increase in the manufacturing value added of one unit leads to a reduction in the registration rate of 11.10%; 6.91% and 3.06% respectively for primary, secondary and tertiary education. The reduction in school enrollment due to industrialization is explained by the fact that industrialization attracts young people to work in factories and according to Le Brun et al. (2011), it is difficult to combine manufacturing work and schooling. In addition, this result can also be explained by the fact that industrialization increases the need of young people to provide help at home, especially since SSA is the region that concentrates the highest rate of monetary poverty (41%) in the world (World Bank, 2016) and the least work opportunity is seized by young people in order to improve their financial situation (see that of their family) often to the detriment of their education. We retain from this analysis that in a context of ambient poverty, industrialization increases the opportunity cost of education. This result is consistent with the work of De Pleijt (2018) who showed that industrialization has led to declining demand for education and literacy in England. The same observation has been made about the level and growth of secondary education in the United States (Goldin & Katz, 1997).This situation has been described by Sanderson (1972) and Nicholas and Nicholas (1992) as the "deskilling hypothesis".

Columns (4-6) repeat the estimates from columns (1-3) by adding other control variables (government effectiveness and political stability), the objective being to test the sensitivity of our results. The results obtained show that the coefficients of the variables in columns 1-3 retain not only their signs but also their significance.

Considering that women have the primary responsibility for performing household chores, including fetching water (Elson, 1995) and that in non-industrialized countries, men control land, finances, industry and government, and therefore access to water (Crow & Farhana, 2002); women would be better placed to master the various constraints related to access to water. To this end, can a significant increase in women's access to power bodies (in parliament, for example) play an important role in the transmission of the effects of access to water on education?

Table V gives the results of the effect of access to water on education, highlighting the role of women parliamentarians. The results of this table show that access to water has a negative and significant effect on all three levels of education. In contrast, the interaction variable (water * woparl) has a positive and significant effect on the three levels of education (column 1-3).This result can be explained by the fact that a significant proportion of women parliamentarians can constitute a lobby able of bringing the suffering of populations who have difficulty accessing drinking water to political decision-makers so that the latter can provide solutions for the greatest happiness of the populations. This improved access to water will not only decrease the time that students spent per day collecting water and will consequently decrease the school exclusion rate and improve the school performance of students. Given the fact that the sign of the interaction variable is different from the sign of the direct effect (no synergy effect), net effects are therefore necessary according to the contemporary literature (Asongu & Nwachukwu, 2017; Asongu. & Nchofoung, 2021). In the calculation process, the net effect of the effect of the interaction between women parliamentarians and access to water is -0.1009 for primary education (column 1). This value is obtained as (-0.1344 + (17.62 * 0.019)). In this calculation, 0.0019 is the interactive effect coefficient, -0.1344 is the direct effect coefficient and 17.62 is the average of the proportions of women parliamentarians as shown in the descriptive statistics table. By applying the above calculation in all our transmission mechanisms, it appears that despite the positive interactive effect of the variable women parliamentarians in the transmission of the effect of access to water on education, the direct negative effect outweighs this positive interactive effect producing net negative effects of access to water on the three levels of education for our sample. This result reveals that there is a threshold of women parliamentarians from which access to water contributes positively to education in SSA.

Table-4. Effect of water access on education.

Variables	1	2	3	4	5	6
	Peducation	**Seducation**	**Teducation**	**Peducation**	**Seducation**	**Teducation**
Water	-0.1386*** (0.00)	-0.0293* (0.06)	-0.0077*** (0.00)	-0.1094*** (0.00)	-0.0292** (0.02)	-0.0143*** (0.00)
Agriculture	-0.8026*** (0.00)	-0.0245** (0.01)	-0.0076*** (0.00)	-0.0827*** (0.00)	-0.0733*** (0.00)	-0.0079** (0.01)
Popgr	-1.8209*** (0.00)	-0.6290* (0.06)	-0.4239*** (0.00)	-1.5649*** (0.00)	-0.7295** (0.02)	-0.3705*** (0.00)
Manuf	-0.1110** (0.03)	-0.0681* (0.05)	-0.0306*** (0.00)	-0.1137*** (0.00)	-0.1427*** (0.00)	-0.0649** (0.01)
Sanitation	0.0143 (0.7)	-0.0026 (0.8)	0.0011 (0.6)	-0.0071 (0.8)	-0.0156 (0.51)	-0.0031 (0.4)
Goveff				-1.3145 (0.2)	1.1832* (0.08)	0.8219*** (0.00)
Polist				0.5806 (0.3)	-0.2322 (0.6)	-0.0995 (0.18)
Lag dependant	0.9386*** (0.00)	1.0216*** (0.00)	0.9974*** (0.00)	0.9412*** (0.00)	1.0123*** (0.00)	1.0123*** (0.00)
Cons	22.5369*** (0.00)	5.1348*** (0.00)	2.3424*** (0.00)	19.9513*** (0.00)	8.8303*** (0.00)	3.5026*** (0.00)
AR(1)	0.02	0.02	0.00	0.02	0.02	0.00
AR(2)	0.92	0.13	0.45	0.88	0.13	0.40
Prob(Sargan)	0.98	0.21	0.92	0.98	0.19	0.93
Prob(Hansen)	0.99	0.75	0.34	0.727	0.67	0.36
Instruments	17	22	20	23	22	23
N. Obs	414	414	414	414	414	414

Note: ***, **, *: represent the significance thresholds at 1%, 5% and 10% respectively. Values in parentheses represent probabilities.

The political thresholds for the variable women parliamentarians that cancel out the negative effect of access to water on the three levels of education in our sample are 70.73; 22.47 and 35.66 are respectively for primary, secondary and tertiary education. The threshold of a variable is obtained by setting the derivative of the education variable with respect to this variable (women parliamentarians) equal to zero. Simply put, the threshold is the ratio of the unconditional effect to that of the conditional effect. Apart from the threshold of women parliamentarians necessary for access to water to positively impact primary education, the other threshold values affect policies here, because they are within the range of values reported in descriptive statistics (1.2 <threshold of women parliamentarians <44.5).

Apart from the interaction variable (water * woparl), we have also introduced another interaction variable that links access to water and government efficiency (Water * Goveff). By deploying the same techniques as before (calculation of net effects and calculation of the threshold), we found that despite the positive interactive effect of the variable government efficiency in the transmission of the effect of access to water on education, the direct negative effect outweighs this positive interactive effect producing net negative effects of access to water on the three levels of education for our sample (column 4-6). Moreover, the policy thresholds for the government efficiency variable that cancel out the negative effect of access to water on the three levels of education in our sample are 1.3; 1.24 and 0.73 are respectively for primary, secondary and tertiary education.

4. CONCLUSION AND POLICY IMPLICATIONS

Several studies have been carried out within the framework of water access. However, no macroeconomic study has focused on the link between water access and education specifically in sub-Saharan African countries. This article examines how water access influences education in sub-Saharan Africa. Thus, this is the analysis of 23 countries in sub-Saharan Africa during the period 2000-2018. To carry out our investigation, the Generalized Moments Methods were used. Three main results emerged from this study. First, there is a negative relationship between water access and education. Second, the introduction of Parliament Women and goverment effectiveness have allowed us to see that they are channels through which SSA can improve the effectiveness of the water access towards education. Finally, the positive association between water access and education in sub-Saharan Africa is conditioned by the achievement of a certain threshold of parliament women and goverment effectiveness. Thus, it is important for the various African governments to encourage more women to access positions of power. Because a significant representation of the latter in the bodies of power (such as parliament) will allow them to plead nearby political decision-makers for an improvement in access to drinking water, which improvement has a positive impact on education. In addition to this measure, African leaders must further integrate the problem of access to water in their priorities because its scarcity has negative repercussions on education, health and many other sectors of activities.

Table-5. water access, parliament women and education.

	1	2	3	4	5	6
Variables	Peducation	Seducation	Teducation	Peducation	Seducation	Teducation
Water	-0.1344*** (0.00)	-0.1461*** (0.00)	-0.0321*** (0.00)	-0.0613* (0.05)	-0.0608*** (0.00)	-0.0090** (0.04)
Agriculture	-0.0658*** (0.00)	-0.0157 (0.3)	-0.0088*** (0.00)	-0.1042*** (0.00)	-0.0246*** (0.00)	-0.0036 (0.1)
Popgr	0.4667 (0.1)	-1.7030** (0.01)	-0.5023*** (0.00)	-0.7061** (0.04)	-0.9473** (0.02)	-0.1661** (0.03)
Manuf	0.0130 (0.8)	-0.0997** (0.03)	-0.0254** (0.01)	-0.0474 (0.14)	-0.1487*** (0.00)	-0.0051 (0.37)
Sanitation	0.0331 (0.3)	-0.0486* (0.6)	-0.0009 (0.7)	-0.0370* (0.09)	-0.0041 (0.5)	0.0129** (0.02)
Woparl	-0.1612*** (0.00)	-0.2905*** (0.00)	-0.5538*** (0.00)			
Goveff				-2.3615 (0.1)	-2.2322* (0.09)	-0.9078*** (0.00)
Water*Woparl	0.0019** (0.04)	0.0065*** (0.00)	0.0009*** (0.00)			
Water*Goveff				0.0468** (0.03)	0.0487** (0.01)	0.0123*** (0.00)
Lag dependent	0.9551*** (0.00)	0.9860*** (0.00)	0.9971*** (0.00)	0.9447*** (0.00)	1.0446*** (0.00)	0.9857*** (0.00)
Cons	13.5035*** (0.00)	15.8267*** (0.00)	3.9291*** (0.00)	15.7501*** (0.00)	8.0945*** (0.00)	0.9122*** (0.00)
Net effects	-0.1009	-0.0315	-0.0162	-0.1006	-0.1017	-0.0193
Threshold effects	**70.73**	**22.47**	**35.66**	**1.30**	**1.24**	**0.73**
Prob(CHI2)	0.00	0.00	0.00	0.00	0.00	0.00
AR(1)	0.02	0.02	0.00	0.02	0.03	0.00
AR(2)	0.95	0.13	0.46	0.93	0.13	0.48
Prob(Sargan)	0.79	0.22	0.92	0.63	0.86	0.32
Prob(Hansen)	0.85	0.64	0.43	0.66	0.85	0.29
Instruments	22	22	21	21	22	21
Nb. Observations	414	414	414	414	414	414
Countries	23	23	23	23	23	23

Note: ***, **, *: represent the significance thresholds at 1%, 5% and 10% respectively. Values in parentheses represent probabilities.

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APPENDICES

Table-A1. List of countries.

Angola	Guinea	Nigeria	Zambia
Burkina Faso	Kenya	Senegal	Zimbabwe
Cameroon	Madagascar	Sierra Leone	
Chad	Malawi	Soudan	
Congo	Mali	South Africa	
Congo, Dem. Rep	Mozambique	Tanzania	
Cote d'Ivoire	Niger	Uganda	

Table-A2. Variable definitions.

Variables	Signs	Variables definition (measurement)	Sources
Manufacturing	Manuf	Manufacturing, value added (% of GDP)	World Bank (WDI)
Agriculture	Agriculture	Added value of agriculture (% of GDP)	World Bank (WDI)
Population	Popgr	Population growth (annual %).	World Bank (WDI)
Parliament women	Woparl	Proportion of seats held by women in national parliaments (%)	World Bank (WDI)
Primary education	Primary	School enrollment, primary (% gross)	World Bank (WDI)
Secondary education	Secondary	School enrollment, secondary (% gross)	World Bank (WDI)
Water	Water	People using at least basic drinking water services (% of population)	
Tertiary education	Tertiary	School enrollment, Tertiary (% gross)	World Bank (WDI)
Sanitation	Sanitation	People using at least basic sanitation services (% of population)	World Bank (WDI)
Governent Effectiveness	goveff	Government effectiveness (measured by perceptions of the quality of public services, the quality of the public service and its degree of independence from political pressures, the quality of policy formulation and implementation, and credibility of the government's commitment to these policies. It is between -2, 5 and 2.5)	WGI, World Bank
Political stability	Plista	Political Stability and Absence of Violence/Terrorism measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.	WGI, World Bank