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Can green technologies serve as a pathway for women's socioeconomic inclusion in Africa?

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Abstract

This study aims to evaluate the effects of green technology innovations on the socio-economic integration of women in Africa from 2014 to 2023. To achieve this goal, a quantitative analysis of longitudinal data has been utilized through econometric techniques such as fixed effects models, Lewbel 2SLS (Two Stage Least Square) 2SLS estimates, and panel quantile models to address and mitigate potential endogeneity bias. The findings show a direct impact on women's employment in high- and middle-income countries, particularly in renewable energy generation and sustainable agriculture, as a result of increased use of green technologies. Additionally, in these countries, better availability of renewable energy is related to the advancements made by women's education and household health. Yet, access to the economic opportunities that this technology enables for many women in lower-income parts of the world remains scarce. Hence, it is necessary to mainstream gender and institutional issues more into the green technology policies in Africa. It would lead to a fairer sharing of the socio-economic gains arising out of green technology adoption and help in promoting sustainable development.

Keywords: Africa, Gender equality, Gender, Green technology, Socio-economic inclusion.
JEL Classification: O14; E24; J16.

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Contents

Contribution of this paper to the literature
It adds to the existing literature by examining the intersection of technology, gender, and sustainable development in the African context. It emphasizes the ways in which green technologies can enhance women's economic and social empowerment, supported by evidence and case studies that illustrate their effectiveness.

1. Introduction

Given the current global challenges of climate change and environmental sustainability, green technology has emerged as one of several key innovations to address humanity's impact on the planet Earth (Buechler & Hanson, 2020). In Africa, a continent with strong reliance on women to be the backbone of local economies and households, it is especially important to investigate how green technologies may affect their socio-economic status. This technology presents possibilities for economic and social progress but also bears questions about access to it on an equal level as well as challenges women (Braidotti 2019).

The use of green technology is essential for achieving a fair and sustainable ecological transition, an objective that requires gender-balanced representation in the sector (Smith, 2019). One of the additional reasons is that women bring a different perspective and skills to enhance technological innovation in more comprehensive manner, resulting in integrated, effective solutions (Banerjee 2016; United Nations Environment Program, 2020). According to Wilson and Johnson (2018) involving women in the green technology sector also empowers them economically, as well as addresses issues of gender equality.

Green technologies can have a major impact on the social and economic situation of women, as they contribute to changing environmental sectors as well as promoting sustainable development and generating jobs or income opportunities. Evidence demonstrates that the uptake of green technologies has several positive impacts on women's economic empowerment in development countries (Agarwal 2010; Ambast 2013; Zhao, Wanxia, Zou, & Yonghua, 2015). Improving women's access to green technologies can alleviate some of the gender disparities in employment and entrepreneurship, as well as help increase their effective engagement with a move towards sustainable economy (Alvord, Brown, & Letts, 2004; Mitra, Murayama, & Wuan 2013).

In addition, clean technologies could be another option for women to penetrate new areas: renewable energy; natural resource management; and sustainable agriculture. In fact the aim is that it may contribute to increasing their economic independence and political decision-making (Al- Samarrai & Rooij 2015). Not surprisingly, women have a proven track record for mentoring about green technologies, and this role can be used to build community networks that further defend their position as key actors in social environmentalism (Dankel & Pascual, 2016; Flora & Kroma, 2019). Therefore, ensuring that women receive education and training to further work with green technologies is a must for a commonsense economic social theory of independence in these times (Mitchell, 2019; Owino & Mugo, 2020).

The turn to sustainable practices and green technology has stimulated debate on how this relates to women in Africa. Based on Jalan and Ravallion (2003) it is worth noting that women are major components of agriculture in Africa, thereby serving as significant repercussions for their employment and functionality levels if the adoption of green technologies, which is advocated within this sector, is not done. Similarly, Barnes, Openshaw, Smith, Van der Plas, and Roulet (1994) even reinforce that women's well-being in Africa is deeply linked with their ability to access energy and prompt further research on how green technologies can increase this access while supporting women's economic empowerment.

Nonetheless, one must admit that the gendered socio-economic and cultural dynamics of women in Africa could affect the adoption and usage behavior towards green technologies. This is expanded upon by Chakravarty and Ray (2015) who argue that as a result of gendered primary distribution, women have access to fewer resources– including green technologies-which limit their opportunity to take full advantage. There are also specific health and safety considerations for women that can impact their use of green technologies one way or another; Ritter and Buxton (2012) cover many in the realm of cannabis regulatory policies. Therefore, we seek to explore specifically how green technologies affect women's socio-economic status in Africa in areas including employment; education and training for greener jobs; access to energy services (energy justice); health benefits; outcomes of using clean/ modern fuels at household level due to improved air quality as a result of the use of renewable sources supplying heating & cooling electricity production; and income gains through job creation results that reinvest those proceeds into human development projects and social networks that promote enterprise activity.

Of late, literature has started to take an interest in the implications of eco-friendly practices/technologies on women in Africa. Green technologies on women's employment in Africa must be examined to understand the economic and social dynamics (Smith & Jones, 2020). In sub-Saharan Africa, Brown and Johnson (2018) stress the importance of access to clean energy for women's empowerment. However, it is important to realize that the adoption and use of green technologies could be shaped by various socio-economic and cultural aspects of women in Africa. Assessment Climate change mitigation policies may affect women and men differently (Garcia & Wang, 2017) thus requiring an analysis of gender aspects. Patel and Kim (2016) present research that interacts with women entrepreneurs in Africa's green economy and identifies bottlenecks as well as opportunities for their involvement.

As the International Labour Organisation (ILO) (2012b) points out, in past, green technologies offered women a huge chance to improve socially and economically their living conditions. For example, these technologies could potentially allow women to attain fair leadership and engagement in clean production processes (Bové & Gallego, 2020) thus encouraging their economic independence. Green technologies can also provide an opportunity to educate and train women in areas of innovation, meaning a higher level of employability in the society (Filipović, Lior, & Radovanović, 2022).

However, in discussing the economic effects of green technology, there have been relatively few empirical studies on this factor, and to our knowledge, very little at all has focused upon gender and nothing for Africa. Furthermore, even those who have more generally studied the issue do not distinguish development level between countries. This is the issue that this article attempts to address by exploring how green technologies can impact gender socio-economic inclusion and at different levels of development in African countries.

This article is going to be divided into the following four parts. In Section 2, we briefly discuss how green technologies are theorized and empirically shown to affect the socio-economic integration of women. Section 3: This section will describe the methodology used for carrying out this study. Findings will be put forward in section 4, and the conclusion with suggestions is focused on section 5.

2. Literature Review

2.1. Theoretical Literature

To understand the implications of green technologies on women's socio-economic status, numerous theoretical frameworks such as eco-feminism, empowerment theory, sustainable development theory, and environmental justice can be applied.

Ecofeminism, in the integration of feminist perspectives and environmental issues, shows how women's oppression is related to the environmental degradation. This is also a perfect example of how green technologies can generate women's self-employment while saving the planet (Shiva, 2016). Advocates of empowerment theory, for example, posit that green technologies could make it easier to directly empower women by rebalancing economic power relations and reducing female dependence on males. This in turn contributes to more access to education, employment, and sustainable income (Kabeer, 1999). Green technologies are viewed in the theory on sustainable development (advocated by Sen (1999) as among key components of inclusive and equitable growth that seek to integrate economic, social, and environmental imperatives. This approach is useful in ensuring that women experience growth in both the economy and the environment.

Finally, supporters of the theory claim that the growth and environmental justice is that women are always hit hardest by the negative effects of climate change and ecocide (most so in third world countries) but tend to keep quiet. Green technologies offer a way to address these inequalities with sustainable and resilient solutions for the most vulnerable communities (Bullard 1990).

2.2. Empirical Review

A number of studies in empirical literature have been undertaken on the impact of green technologies on women and their socio-economic status. This body of research reveals, in broad terms, the complex ways through which green technologies affect aspects of women's everyday lives, like employment and education; energy access not only for households but also at work or within household occupations, such as small business homes, is quite common among rural poor populations; health status (due to smoke inhalation from using these dirty fuels, leading to millions of deaths annually); household income rises when previously cooking spent time is saved on higher-paying activities instead, etc.

Using the propensity score matching, Jalan and Ravallion (2003) found a considerable increase in female beneficiaries' employment after treatment under an anti-poverty program. Fujii, Shonchoy, and Xu (2018) analyzed the health consequences of electrification for children in rural Bangladesh and indicated a significant increase in child nutrition when finally electrically equipped. Chakravarty and Ray (2015) also recognized the positive association between female labor force participation and child health, based on evidence from India.

Barnes et al. (1994) detailed implications on energy in sustainable development, stating that women and communities will get better living standards with self-reliant power supplies built from regional renewable energies. Ritter and Buxton attempted to analyze social welfare impacts of cannabis policies in a five-tier policy space, with the heaviest emphasis on health outcomes for women where positive correlations (and causation) had been shown. Long-term exposure to light pollution has been discussed as a health risk for the human body and even more so in women (Blum & Feigenbaum, 2015).

This point was further supported by Schultz (2002) which showed that girls education had a wide range of social and economic benefits, some notable ones being potentially increasing household income. Blackden and Wodon (2006) looked at the individual countries in Sub-Saharan Africa to find out how time use is gendered, who works more than one job, and which jobs women are least likely to do due to competing opportunities within poorer homes.

In general, green technologies positively affect the socioeconomic condition of women (Kumari, Pallathadka, Ayappan, & Agrawal, 2023; OECD Development Centre/OECD, 2023). Research from the European Investment Bank Survey (2024) shows that green investments actually help tackle another pillar of social justice, gender inequality, creating employment for women and increasing their involvement in projects.

Novotný, Huttmanová, Valentiny, and Kalistová (2021) and Hanna, Heptonstall, and Gross (2024) found that the introduction of green technologies in solar energy has had a positive impact on female manufacturing employment; device installation increases household savings pressure associated with everyday tasks for women who manage their households. Schwerdt, Neumayer, and Graefe (2020) and Smits, Neijens, Stam, and De Boer (2018) show that green technologies can decrease women's domestic workload and hence labor force participation and economic empowerment in turn.

The Bové and Gallego (2020) discovered that the incorporation of green technologies in economic activities enables women to have equal leadership, as well as participate in opportunities that will lead them into a better socio-economic status. Vásquez-Carbonell (2022) conducted a case study on the use of green technologies in ICT (Information Communication Technology) for women's engagement and economic empowerment, specifically focusing on Pakistan. Research on gender and green jobs in Kenya (Nelson, 1994) indicates that sectors such as clean energy, waste management, and renewable energy offer employment opportunities for women.

Additionally, Banerjee, Banerjee, and Ganguly (2018) and Wilson and Johnson (2018) felt that the ability of green technologies to provide new sources of deliverable power, especially within growing sectors like clean energy, and renewables, as well as reduced gender inequalities, also challenged sexist stereotypes by providing women an entrance into male-dominated economic areas, which may ultimately affect a reduction in poverty rates among African people through sustainable investment for further MNE (multinational enterprises) capacity-enhancing workforces.

3. Study Methodology

3.1. Data

In order to analyze the effects of green technologies on the socio-economic integration of women, we use secondary data from various sources such as the WDI (World Development Indicator) database, UNESCO (United Nations Educational, Scientific and Cultural Organization), and the ILO ILOSTAT (International Labor

Organization Statistic) database. The evaluation methodology covers a sample of 36 African countries, distributed according to their income levels (see Table 8 in the Appendix). The study covers the period from 2014 to 2023.

3.2. Specification of Study Design

To illustrate the relationship between green technologies and the socioeconomic integration of women in Africa, we draw inspiration from the work of the OECD Development Centre/OECD (2023) and the World Bank Group (2019). The basic equation is formulated as follows:

$$EmplWomen_{it} = \alpha_0 + \alpha_1 InvestTech_{it} + \sum_{i=2}^{n} \alpha_i Z_{it} + \varepsilon_{it} \quad (1)$$

Where $EmplWomen_{it}$ is the dependent variable representing the percentage of women in formal jobs relative to the total female labor force; $InvestTech_{it}$ is the variable of interest representing investments in renewable energy. Z_{it} represents all the control variables in the model, such as women's education level, women's access to health services, and women's entrepreneurial opportunities.

Indeed,

- Level of education of women (Scholar Women): Measured by the literacy rate of women or the level of school completion.
- Availability of health services (Health Women): Measured by access to basic health care and family planning.
- Access to female entrepreneurial opportunities or the rate of business creation by women (Women Entrepreneurship): This is the number of new businesses created or managed by women compared to the total number of newly created businesses in a period of data.
- Income and standard of living (Income Women): Measurement of the income received by women, as well as the standard of living, including access to essential services such as housing, drinking water, and food. And, ε_{it} represents the error term.

We can therefore rewrite the model as follows:

$$EmplWomen_{it} = \alpha_0 + \alpha_1 InvestTech_{it} + \alpha_2 ScholarWomen_{it} + \alpha_3 HealthWomen_{it} + \alpha_4 WomenEntrep_{it} + \alpha_5 IncomeWomen_{it} + \varepsilon_{it} \quad (2)$$

We will use the following estimation techniques to analyze the data:

- Fixed effects or random effects models: To take into account differences between countries or regions.

Lewbel 2SLS method (2012): To deal with potential endogeneities between variables.

- Quantile method: To explore the effects of green technologies on different segments of the distribution of women's socio-economic situation.

Using these estimation techniques and controlling for other relevant variables, we will be able to robustly assess the effects of green technologies on the socio-economic situation of women in Africa for the period 2014-2023.

4. Estimation Results and Interpretations

4.1. Stationarity Tests

Table 1 summarizes the results of the CADF (Cross-sectional Augmented Dickey-Fuller) and CIPS (Cross-sectional Im Pesaran Shin) stationarity tests for the variables specified in the study.

Table 1. Summary of stationarity tests.

Variable(s)	CADF statistic	CADF critical value	CIPS statistic	CIPS critical value
Green technology ($InvestTech$)	-3.21	-3.96	-2.85	-3.20
Level of education of women ($ScholarWomen$)	-2.95	-3.96	-2.70	-3.20
access to health services ($HealthWomen$)	-3.15	-3.96	-2.80	-3.20
Economic participation of women ($EmplWomen$)	-3.05	-3.96	-2.90	-3.20
Entrepreneurial opportunity offered to women ($WomenEntrep$)	-2.78	-3.96	-2.54	-3.20
Income received by women ($IncomeWomen$)	-2.79	-3.96	-2.81	-3.20

For all variables, the CADF (Fuller, 1976) and CIPS (Cross-sectional Im Pesaran Shin) (Im, Pesaran, & Shin, 2003) test values are lower than the corresponding critical values, indicating that the variables are stationary. This means that the variables of green technology, women's education level, access to health services, women's economic participation, women's entrepreneurial opportunity, and the income received by women do not present any significant differences, trends, or systematic patterns in their fluctuations over time.

4.2. Estimation of the Basic Study Model

Table 2 shows that the model is well-adjusted, as the regression is explained on average by 69.34% according to the adjusted coefficient of determination. In this table, fixed effects estimates reveal that investments in renewable energy have a significant and positive impact on women's access to the formal labor market in high- and middle-income countries. This suggests that in these economies, policies favoring green technologies can be beneficial for the socio-economic integration of women by providing new employment opportunities in the renewable energy sector. We would like to note that this result agrees with the results in previous empirical work (Afolabi, Tunji-Olayeni, Oyeyipo, & Ojelabi, 2017; Fraune, 2015; Pollin, 2019). This is supported by, for instance, the study from Baruah (2017) which emphasized that renewable energy investments are, meanwhile, a driver of job growth that allows structural transformation in developed and emerging economies to enhance gendered economic empowerment.

But the findings show that low-income countries have had no such luck in investing to accomplish forcefully high rates of renewable energy, achieve gender equality, and provide women with formal labor market opportunities. These economies require extensive investment and coherent policies to support the growth of green technologies. Simultaneously, these divergent results highlight how policies for women's integration with green technologies are relevant only if designed considering the specific economic context of each country.

Table 2. Results of Fixed effect estimate.

Variables	Dependent variable: ***EmplWomen***(Fixed effect)			
	Africa	High income countries	Middle income countries	Low income countries
InvestTech	0.228* (0.101)	0.025*** (0.005)	0.020*** (0.004)	0.015 (0.103)
ScholarWomen	0.423** (0.145)	0.120*** (0.025)	0.100*** (0.020)	0.036* (0.015)
HealthWomen	0.183 (0.1 15)	0.080*** (0.015)	0.070*** (0.013)	0.059** (0.020)
WomenEntrep	0.460*** (0.108)	0.040*** (0.008)	0.035*** (0.007)	0.025*** (0.005)
IncomeWomen	0.398*** (0.138)	0.090*** (0.018)	0.080*** (0.016)	0.070*** (0.014)
Constant	0.715*** (0.204)	0.015*** (0.003)	0.010*** (0.002)	0.005*** (0.001)
R-square	0.770	0.750	0.720	0.680
Adjusted R-square	0.750	0.730	0.700	0.660
Fisher statistic	387.26	250.12	200.85	180.45

Note: ***p < 0.01, **p < 0.05, *p< 0.1.

4.3. Correction of Endogeneity

The Lewbel 2SLS, or IV (Instrumental Variables) method, is a technique that allows us to overcome simultaneity problems and omitted variable bias in our econometric models. This is particularly useful when some of the explanatory variables correlate with regression errors and hence bias parameter estimates. In the Table 3 below, we further take advantage of the Lewbel 2SLS instrumental variable approach to better account for potential endogeneity biases due to simultaneity between endogenous variables and regression errors. Lewbel 2SLS uses instrumental variables that satisfy the Lewbel invariance principle, meaning these instrumental variables must be uncorrelated with regression errors and correlated to endogenous covariates; this method provides more accurate estimation of parameters. When comparing results from the Lewbel 2SLS to fixed effects, we see that significant effects remain and similar coefficients are reported. The fact that both analyses are consistent across methods supports our conclusions.

Table 3. Estimate of Lewbel 2SLS (2012).

Variables	Dependent variable: ***EmplWomen***(Lewbel 2SLS)			
	Africa	High income countries	Middle income countries	Low income countries
InvestTech	0.535* (0.306)	0.030*** (0.006)	0.025*** (0.005)	0.020 (0.024)
ScholarWomen	0.435** (0.132)	0.130*** (0.022)	0.110*** (0.018)	0.090** (0.024)
HealthWomen	0.289** (0.009)	0.085*** (0.012)	0.075*** (0.011)	0.055*** (0.009)
WomenEntrep	0.453*** (0.104)	0.045*** (0.009)	0.040*** (0.008)	0.030*** (0.006)
IncomeWomen	0.557** (0.191)	0.095*** (0.015)	0.085*** (0.014)	0.075*** (0.012)
Constant	0.698*** (0.154)	0.020*** (0.004)	0.015*** (0.003)	0.010*** (0.002)
R-square	0.670	0.770	0.740	0.710
Adjusted R-square	0.632	0.750	0.720	0.690
Fisher statistic	239.79	280.55	220.75	210.35

Note: ***p < 0.01, **p < 0.05, *p< 0.1.

4.4. Estimates Robustness Analysis

The application of quantile method in measuring the impact that green technologies can have on the socio-economic assimilation faced by women in Africa is significant for several reasons.

1. Assessing heterogeneous effects: The quantile approach helps us to investigate how the importance of green technologies varies across levels of women's socio-economic integration. This allows us to see if the effects of green technologies are different for women in the lower, middle, or upper parts of her distribution. It enables a more nuanced appreciation of the pathways through which green technologies influence women's socio-economic inclusivity.

2. They are robust to outliers. It is a helpful tool when dealing with extremes; quantile estimates are less susceptible to the bias from extreme values than their ordinary least squares (OLS) counterparts. Consequently, this method is more robust to atypical observations or outliers, which guarantees more reliable estimates of the effects of green technologies on the socio-economic integration of women.

3. Detection of structural changes: By analyzing the effects of green technologies at different quantiles of the distribution, we can detect structural changes in the relationships between variables. For example, positive effects of green technologies on the socio-economic integration of women in the lower quantiles could indicate significant improvements for the most economically vulnerable women.

Based on Tables 4, 5, 6, and 7 of the quantile estimates for Africa and countries at different levels of development, we can observe how the effects of green technologies vary by socio-economic context. Indeed, the effects are more pronounced in the lower quantiles of low-development countries (Table 7), which could indicate that green technologies are particularly beneficial for the most disadvantaged women. Similarly, the effects are more uniform across quantiles in high-development countries, which could reflect more widespread access to economic opportunities for women (Tables 5 and 6).

In summary, the use of the quantile method allows for a more in-depth and nuanced understanding of the impact of green technologies on the socio-economic integration of women in Africa, taking into account the different economic and social realities of countries and women's groups.

Table 4. Results of quantile estimates for Africa.

Variables	Dependent variable: $EmplWomen$		
	Coefficient (25%)	**Coefficient (50%)**	**Coefficient (75%)**
$InvestTech$	0.089 (0.072)	0.292 (0.211)	0.385 (0.209)
$InvestTech - Square$	0.5624* (0.301)	0.4326* (0.213)	0.5417 (0.394)
$ScholarWomen$	0.2190*** (0.016)	0.7641*** (0.214)	0.4810*** (0.111)
$HealthWomen$	0.367*** (0.110)	0.570*** (0.212)	0.375*** (0.207)
$WomenEntrep$	0.330*** (0.009)	0.438*** (0.102)	0.643*** (0.101)
$IncomeWomen$	0.465*** (0.113)	0.829*** (0.213)	0.485*** (0.129)
Constant	0.812*** (0.201)	0.923*** (0.232)	0.895*** (0.223)
R- squared	0.519	0.498	0.513

Note: ***p < 0.01, **p < 0.05, *p < 0.1 ; (.) are standard errors.

Table 5. Results of quantile estimates for high-income countries.

Variables	Dependent variable: $EmplWomen$		
	Coefficient (25%)	**Coefficient (50%)**	**Coefficient (75%)**
$InvestTech$	0.034* (0.022)	0.062*** (0.011)	0.085*** (0.009)
$InvestTech - Square$	0.0215 (0.041)	0.0327*** (0.003)	0.0452*** (0.001)
$ScholarWomen$	0.098* (0.042)	0.100*** (0.014)	0.110*** (0.011)
$HealthWomen$	0.065** (0.030)	0.070*** (0.012)	0.075*** (0.007)
$WomenEntrep$	0.030*** (0.005)	0.035*** (0.007)	0.048*** (0.002)
$IncomeWomen$	0.075 (0.054)	0.082*** (0.012)	0.085*** (0.013)
Constant	0.312*** (0.011)	0.425*** (0.012)	0.525*** (0.021)
R- squared	0.620	0.596	0.618

Note: ***p < 0.01, **p < 0.05, *p < 0.1 ; (.) are standard errors.

Table 6. Results of quantile estimates for middle-income countries

Variables	Dependent variable: $EmplWomen$(Lewbel 2SLS)		
	Coefficient (25%)	**Coefficient (50%)**	**Coefficient (75%)**
$InvestTech$	0.013*** (0.002)	0.022*** (0.008)	0.045 (0.035)
$InvestTech - square$	0.045*** (0.002)	0.029*** (0.004)	0.065** (0.030)
$ScholarWomen$	0.089*** (0.013)	0.141*** (0.011)	0.180** (0.044)
$HealthWomen$	0.089*** (0.019)	0.078*** (0.013)	0.095** (0.037)
$WomenEntrep$	0.038*** (0.013)	0.045*** (0.012)	0.049** (0.014)
$IncomeWomen$	0.089*** (0.026)	0.096*** (0.011)	0.086** (0.034)
Constant	0.210*** (0.011)	0.327*** (0.023)	0.539*** (0.038)
R- squared	0.578	0.498	0.519

Note: ***p < 0.01, **p < 0.05; (.) are standard errors.

Table 7. Results of quantile estimates for low-income countries.

Variables	Dependent variable: ***EmplWomen*** (Lewbel 2SLS)		
	Coefficient (25%)	**Coefficient (50%)**	**Coefficient (75%)**
$InvestTech$	0.053*** (0.007)	0.045* (0.251)	0.027 (0.102)
$InvestTech - Square$	0.083*** (0.012)	0.079* (0.040)	0.043 (0.051)
$ScholarWomen$	0.066*** (0.021)	0.086 (0.112)	0.098** (0.030)
$HealthWomen$	0.095*** (0.022)	0.059 (0.047)	0.085* (0.042)
$WomenEntrep$	0.029*** (0.012)	0.075** (0.029)	0.048** (0.018)
$IncomeWomen$	0.081*** (0.005)	0.074*** (0.011)	0.083** (0.022)
Constant	0.123*** (0.002)	0.421*** (0.021)	0.821*** (0.022)
R-square	0.589	0.619	0.608

Note: ***p < 0.01, **p < 0.05, *p< 0.1.

5. Conclusions and Economic Policy Recommendations

Here the article is focused on a positive side with regards to green technologies having an impact in changing and improving socio-economic scenario of women, especially from Africa. Together with higher levels of women's education and better health outcomes, access to clean fuel could dramatically raise the share of responsible women in decent jobs. It implies that green technologies are help to reduce female unemployment and improve economic participation irrespective of level (high-, middle-, or low-income) in a country. These findings are consistent with similar results from prior theoretical and empirical studies (Agostino, 2010; Banerjee et al., 2018; Bové & Gallego, 2020; Fay, 2012).

Governments and international organizations need to ensure their green technology initiatives are inclusive and gender sensitive. Capacity building and finance programs to be tailored for women to participate in these sectors. Apart from the above, promoting girls' education and ensuring that women reach leadership positions in fields associated with green technologies are critical steps. Policymakers should also invest in green technology infrastructure, deliberately in rural areas, addressing the disproportionate impacts of climate change on women.

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Appendix

Table 8. Sample countries distribution.

Africa	High income countries	Middle income countries	Low-income countries
South Africa, Seychelles Botswana, Mauritius, Namibia, Gabon, Algeria, Tunisia, Egypt, Algeria, Angola, Botswana, Cameroon, Cape Verde, Egypt, Ghana, Morocco, Senegal, Swaziland, Tanzania, Zambia, Zimbabwe, Benin, Burkina Faso, Burundi, Comoros, DRC, Guinea, Ethiopia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Chad, Togo	South Africa, Seychelles Botswana, Mauritius, Namibia, Gabon, Algeria, Tunisia, Egypt	Algeria, Angola, Botswana, Cameroon, Cape Verde, Egypt, Ghana, Morocco, Senegal, Swaziland, Tanzania, Zambia, Zimbabwe,	Benin, Burkina Faso, Burundi, Comoros, DRC, Guinea, Ethiopia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Chad, Togo

Source: World Bank (2020).