International Journal of Strategic Management and Economic Studies (IJSMES)
ISSN: 2791-299X

Environmental quality, poverty and household health in Benin

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Abstract: The relationship between environmental quality, poverty, and household health is central to sustainable development policy concerns. This paper explores the complex interrelationships between environmental quality, poverty, and household health in Benin. It draws on secondary data and a critical literature review to highlight the role of environmental factors in the deterioration of the health of vulnerable populations. The results show that poor households are the most exposed to environmental risks such as pollution, unsanitary conditions, and limited access to safe drinking water and sanitation. The article offers an integrated perspective on these issues, drawing on environmental justice and capabilities approaches. It recommends the implementation of multisectoral public policies that promote a healthy environment, an essential condition for the sustainable fight against poverty and the improvement of health.

Keywords: Environment - Conditional mixed process technique - precariousness - health risks - unvirtuous behavior.

Digital Object Identifier (DOI): https://doi.org/10.5281/zenodo.**17864240**

Published in: Volume 4 Issue 6

1. Introduction

Benin, like many sub-Saharan African countries, faces a triple vulnerability: environmental, social, and health-related. Despite long-standing sectoral public policies addressing these areas, disadvantaged populations, particularly women and children, remain more exposed to environmental health risks. Adopting an integrated approach is therefore urgently needed.

Environmental degradation (air and water pollution, waste management, unsanitary conditions) is a key factor in respiratory, infectious, and chronic diseases. The WHO (2022) estimates that more than 24% of diseases worldwide are attributable to environmental factors. Studies such as those by Smith et al. (2019) and Brunekreef & Holgate (2002) have demonstrated a strong link between urban air pollution and cardiovascular and respiratory diseases.

Environmental degradation has become a growing concern in developing countries. These countries are characterized by a high number of poor people who tend to overexploit resources unsustainably, which

can lead to environmental destruction (Finco , 2009). For Dhrifi et al. (2020), poverty, viewed from a broader perspective, is the primary source of environmental damage in developing countries. Indeed, the well-being of the poor is linked to the environment in terms of livelihoods, health, and vulnerabilities (Bryceson , 2002). Thus, the negative impact of environmental degradation on the living conditions and health of poor households constitutes a major challenge.

The relationship between poverty and environmental degradation is bidirectional. In other words, each of these problems can become the cause of the other. Poverty in its extreme forms places populations in situations of "survival" and "dependence" on the environment, leading them to perpetually degrade it (Cavendish, 2000; Khan et al. , 2021). Indeed, meeting the subsistence needs of poor households can lead them to destroy ecosystems and overexploit resources. As such, poverty reduction is considered a factor that exacerbates environmental degradation (World Bank, 1996; Gray and Moseley, 2005; Bremner et al. , 2010). The environment also impacts the living conditions of households. In fact, it perpetuates poverty and can even lead to the impoverishment of wealthy populations. Soil degradation due to erosion, the use or misuse of chemicals, overgrazing, or salinization resulting from poor water resource management leads to a loss of income for small farmers and condemns them to poverty (Bucknall et al. , 2000) . The poor are partly responsible for environmental damage but are also its victims. However, environmental degradation not only affects economic assets but also threatens public health .

problems are linked to poverty among the population, but also to inadequate sanitation in housing (Garriga and Foguet , 2013). Poor domestic and food hygiene can expose the poor to environmentally related diseases (Mensah et al. , 2022). Households with low disposable income have fewer options and are more likely to find themselves living in unsanitary housing (Howden- Chapmen et al. , 1996; Govender et al. , 2011). In developing countries, the majority of these dwellings lack latrines and waste management systems. Residents resort to less convenient waste disposal practices and mostly defecate in the open. These practices put pressure on the environment and human health. An unhealthy environment is a source of disease and can restrict economic activities (Mbuya and Humphrey, 2016; Augsburg and Rodriguez- Lesmes , 2018; Wang and Shen, 2022).

According to the WHO (2006), approximately one-quarter of the disease burden and all deaths were attributable to environmental factors. The main environmental dimensions considered that can affect individuals' health status include air quality, the degradation of which is identified as the most dangerous environmental factor for health, water quality, particularly in developing countries, and the large-scale use of pesticides. In 2012, approximately 12.6 million people died as a result of living or working in unsanitary conditions. More than 1.7 billion people still lack basic sanitation services such as private toilets or latrines. Among them, 494 million still defecate in the open, in gutters, behind bushes, or in bodies of water, with significant health consequences (Hammer and Spears, 2016; WHO, 2019). In 2020, 45% of domestic wastewater generated worldwide, from 52% of the total population, was discharged into the environment without safe treatment (Whately et al. , 2020). Sanitation problems persist to such an extent that they hinder the potential of developing countries to pursue other development goals (Diep et al. , 2021).

In Benin, slightly more than one in ten households (13%) uses improved sanitation facilities. Conversely, approximately nine out of ten households (87%) use unimproved sanitation facilities; this proportion ranges from 78% in urban areas to 94% in rural areas. In more than half of cases (54%), households have no type of toilet: this proportion is significantly higher in rural areas than in urban areas (69% versus 34%). Slightly more than six out of ten households (62%) use wood for cooking, a proportion ranging from 40% in urban areas to 79% in rural areas (EDS, 2017-2018). In terms of hygiene, a large proportion of rural households (77.4%) have no access to any sanitation facilities, and only 6% have access to basic sanitation facilities (JMP, 2017). These key statistics illustrate the degree

of environmental degradation linked to poverty, which can be a source of disease. However, previous studies have often established the link between the environment, poverty, and health at the macroeconomic level, without considering hygiene and sanitation practices, particularly among the poor. The health impact and poor environmental quality represent significant obstacles to improving household living conditions. Thus, household health influences their capabilities (productivity, education, etc.) and their choices (in terms of future investments, budget constraints, etc.) , and ultimately, the trajectory of an economy. Since the poor have only natural resources at their disposal to meet their needs, the question arises: what phenomena link the environment, poverty, and health? In other words, does well-being impact the environment? Conversely, is the environment a factor influencing well-being? The aim of this article is to contribute to the understanding of the links between environment, poverty, and household health, through a non-exhaustive review of the theoretical and empirical literature. More specifically, it seeks to identify the mechanisms linking these three dimensions, in contrast to previous studies that have addressed the relationships in pairs.

To this end, the remainder of the article is organized into three (3) sections. The first presents a synthesis of studies on the link between environmental quality and poverty, and on the other hand, the link between environmental quality and health. The second outlines the study's methodology, specifying the data sources and the estimation method. Finally, the third presents and discusses the results.

1. Literature review

This section establishes a link between environmental quality and poverty, and between environmental quality and health.

❖ Environmental quality and poverty

Poverty reduction and environmental sustainability are two important factors in achieving the Sustainable Development Goals. Therefore, it is important to understand and observe the link between poverty reduction and environmental impact to ensure a sustainable future (Baloch et *al.* , 2020). The rural poor are often concentrated in fragile or less environmentally friendly areas. Consequently, their livelihoods are largely dependent on the use of natural resources and ecosystem services (Barbier, 2010). The majority of poor people in developing countries use natural resources, including agricultural land, extensively to meet their subsistence needs, leading to environmental degradation (Reardon and Vosti , 1992). Furthermore, poverty can drive poor households to adopt environmentally damaging behaviors to satisfy their short-term preferences, such as over-farming or cutting down trees for firewood (World Bank, 1992). Thus, Rostami and Sadati (2008) indicate that the poor are considered both victims and agents of environmental degradation. Victims in the sense that they are more likely to be vulnerable, and agents insofar as they have no other choice but to impoverish the environment.

Research on the link between poverty and the environment reveals two types of causal relationships. First, it highlights a unidirectional relationship between poverty and environmental quality, either from poverty to environmental quality or from environmental quality to poverty (Durning , 1989; Cleaver and Schreiber, 1994; Ekbom and Bojo , 1999; Khan et *al.* , 2021). For all these authors, poverty is at the root of environmental degradation. Thus, the unidirectional relationship between poverty and the environment runs from poverty to the environment. Indeed, they indicate that the very poor are often

landless workers who depend on various natural resources for their subsistence and income generation. To this end, they use wild foods, products such as wood as fuel, or process it into charcoal, as a means of supplementing their income. Thus, environmental resources provide significant contributions to the livelihoods of the poor and contribute to their well-being. The poor are therefore compelled by their circumstances to further degrade the environment. For example, Sunderlin et *al.* (2007) argue that forest degradation is strongly linked to a multidimensional phenomenon of poverty. Zaman et *al.* (2010) note that the effect of poverty on the environment is mediated by overpopulation, as the poor have more children than the non-poor (Zaman et *al.* , 2010). Soltani et *al.* (2014) assert that in rural areas of developing countries like Iran, the poverty-environment nexus is strongly influenced by population density, and the poor depend more heavily on forests than other income groups. Poverty is therefore a product of environmental pollution (Khan and Khan, 2016). However, environmental degradation could also negatively affect the poor, even generating more poverty (Yusuf, 2002). According to Duraiappah (1996), the unsustainable use of natural resources inevitably leads to poverty. On the other hand, environmental degradation lifts the poor out of poverty (Kartiasih and Pribadi , 2020).

The second body of literature has argued that there is a two-way causal relationship between poverty and environmental degradation (Baloch et *al.* , 2020; Kassa et *al.* , 2018). The poverty-CO2 paradox has shown that poverty reduction through economic growth intensifies environmental problems due to extensive production and consumption, up to a certain threshold where CO2 emissions must be reduced to mitigate climate change. Consequently, from the perspective of developing countries, poverty reduction is associated with environmental degradation and therefore compels them to reduce CO2 emissions, which have limited their capacity to reduce poverty levels. At the same time, developed countries have focused on increasing their living standards, thus contributing to environmental degradation (Rizk and Slimane, 2018). The reasons for this can be due to pollutants destroying the air supply, over- extraction of resources leaving little room for future use, or habitat destruction leading to the loss of the resources they once contained (Wulandari and Hayati , 2020). Environmental degradation can have varying degrees of impact on different income groups (Morse, 2018).

- **Environmental quality and health**

Studies examining the link between healthcare expenditures and environmental quality have yielded mixed results (Erdoğan et *al.* , 2019; Çakar et *al.* , 2021). Existing literature notes that air pollution has numerous adverse effects on health and human development (Ganda, 2021; Owusu and Sarkodie , 2020). Yazdi et *al.* (2014); Khoshnevis and Khanalizadeh (2017); and Narayan and Narayan (2008) found a positive relationship between emissions and healthcare expenditures, while Lu et *al.* (2017) and Zaidi and Saidi (2018) demonstrated a negative link. On the one hand, some studies show that environmental pollution can significantly increase residents' healthcare expenditures. Arceo et *al.* Janke (2014) and Ebenstein (2016) analyzed data from Mexico and England and found that increased pollutant

concentration was a significant factor in increasing the likelihood of hospitalization for residents. Ebenstein (2012) and Lu et *al.* (2015) reached a similar conclusion from a study of soil pollution in China, namely that with declining water quality and increasing soil pollution, the health risks and costs for residents will increase considerably. Several studies have noted that air pollution significantly increases residents' healthcare costs (Jing and Bing, 2018; Wong et *al.* , 2017). Furthermore, global variations in healthcare spending have also led to changes in maternal and infant morbidity and mortality (Owusu et al., 2021). In Benin, malaria accounts for 44.9% of healthcare visits and is the leading cause of illness affecting communities (SNIGS, MSP, 2018). The national incidence was 185 cases per 1,000 inhabitants in 2018, particularly among pregnant women and children under five (WHO, 2020).

2. Methodology

This section presents the estimation method and the source of the data used to achieve the objective.

2.1. Presentation of variables

This section describes the variables of interest, including the measurement of the environmental quality index, the multidimensional poverty index, and the health variable.

- ✓ **Environmental Quality Index**

The environmental quality index is an indicator used to measure the degree of environmental degradation caused by human activities. The search for an environmental quality indicator led us to calculate it using data that reflect household behavior contributing to environmental degradation, based on the calculation steps of the Multidimensional Poverty Index by Alkire and Foster (2011). Among these behaviors are poor sanitation conditions (waste management, wastewater, and the near absence of latrines) and the pressure exerted by households on natural resources (use of wood for cooking) (McMichael , 2000). Indeed, populations lacking sufficient income use wood as fuel for cooking. Overcrowding also hinders the development of adequate sanitation systems. This leads households to use streets and vacant lots as a means of wastewater disposal (Dong et *al.* , 2008; Ngnikam et *al.* , 2014). Therefore, to better capture all the behaviors that contribute to environmental degradation, a composite index was developed that takes into account the various forms of pressure exerted by households on the environment. Table 1 presents the different components of the environmental quality index used.

Table 1: Components for calculating the environmental quality index

	Terms and conditions taking values	
	0 (does not contribute to environmental degradation)	environmental degradation)
Degradation into combustibles (d_Combustible)	Electricity LPG natural gas biogas kerosene o home-cooked food	 coal , lignite coal drink straw /shrubs/grass harvest agricultural

	Terms and conditions taking values	
	0 (does not contribute to environmental degradation)	environmental degradation)
		Animal manure
Water degradation (d_Water)	Piped into the dwelling Led to the yard/ground Channelled to the neighbor Public tap/water fountain Cased well or well-protected borehole Protected source Cart with small bottled water reservoir Water sachets	Unprotected well unprotected source river /dam /lake /ponds/ Rainwater Tanker truck
Toilet degradation (d _toilet)	rinse down the drain rinse in the septic tank flush , I don't know where toilet bucket toilets /latrines	flushing toilets in pit latrines rinse somewhere ventilated improved p pit latrine with slab pit latrines without s no installation/bush/terrain composting toilet
Degradation due to garbage (d_Ordure)	dump private or NGO	dump buried burned in the street in the bush/the field
Wastewater degradation (wastewater)	The sewers	gutter closed open gutter septic tank private wells in the street in the bush/the field

Source: Authors based on EDS data (2017-2018)

- ✓ **Multidimensional Poverty Index**

In accordance with the Sustainable Development Goals, five indicators were selected to construct the Multidimensional Poverty Index (MPI), and their corresponding deprivation thresholds are presented in Table 2. Balanced weighting was used because it is considered an appropriate arbitrary normative weighting system (Decanq and Lugo, 2009; Atkinson, 2003). Using the values 0 and 1 for each of the five indicators, different MPI measures were calculated for each household in the sample. First, the incidence rate of multidimensional poverty, which corresponds to the percentage of poor households, was determined. Second, the intensity of multidimensional poverty, which corresponds to the average deprivation of poor households, was calculated. Finally, the adjusted incidence rate of multidimensional poverty was defined. The adjusted incidence rate is used in this study to assess the effect of multidimensional poverty on household environmental quality and health.

Indicator	deprived if …
Education	The head of household did not reach secondary education
Earth	The household has less than 1 ha of cultivated or exploited land.
Funding	The household has not received any funding since the start of its activity
Irrigation	The irrigation system currently in operation on the household farm is drip or none.
Asset ownership	The household has at most one: radio, television, mobile phone, bicycle, motorbike and does not own poultry.

- ✓ **Health variable**

Several indicators are used to measure individual health: health status indicators (expressed negatively or positively), resource indicators expressed in terms of costs (healthcare expenditure per individual), and finally, indicators related to services rendered (number of surgeries performed). In this article, health status is used to approximate the health variable. In the literature, health status is captured either by endemic diseases, by their cause, or by the consequences of these diseases (Sermet and Cambois, 2002). Most African countries are characterized by a high rate of malaria endemicity, with fever being the most frequently used symptom for the presumptive diagnosis of malaria in the home (D'Alessandro and Buttiens , 2001; Brasseur et al., 2014). Therefore, in our study, we approximate the health variable with the anemia rate, which is an indicator for measuring malaria prevalence. In households, environmental factors such as poor water quality, the presence of garbage or wastewater, and unpaved floors can lead to fever due to contamination from pathogens (Peterson et al., 2009; Chirebvu et al., 2014; Sy et al., 2014). In neighborhoods, the presence of wetlands or stagnant water promotes the reproduction of vectors, which increases the risk of mosquito-borne diseases (Staedke et al., 2003; Campbell- Lendrum et al., 2015).

2.2. Estimation method

Modeling the effect of environmental quality on poverty and health involves a three-equation system: i) the function of environmental quality determinants related to household behavior, ii) the link between environmental quality and health, and iii) the link between environmental quality and poverty. The different equations are as follows:

$$Y_{1i} = X_{1i}\beta_1 + \varepsilon_{1i}(1)$$

$$Y_{2i} = X_{2i}\beta_2 + Y_1^* w_i + \varepsilon_{2i}(2)$$

$$Y_{3i} = X_{3i}\beta_3 + Y_2^* w_i + \varepsilon_{3i}(3)$$

We use a multi-equation model following Heckman (1976), as shown in equations 1, 2, and 3. In these equations: Y_{1i} represents environmental quality, taking the value 1 if a household degrades the environment and 0 otherwise. Environmental quality is captured by an environmental quality index.

X_{1i} is a vector of variables that determines environmental quality and Y_{2i}represents the health equation. In this article, the health status of individuals is captured by their anemia rate . Thus, we assume that an individual in good health is one who is not anemic.Y_{2i} takes the value 1 if the individual is anemic and the value 0 otherwise, X_{2i}translates a vector of variables that explains the health status of individuals.Y_1^* is the predicted value of environmental quality from equation 1, Y_{3i}represents the poverty equation. Poverty is measured by multidimensional poverty; X_{3i} is a vector of variables affecting the poverty level of individuals, Y_2^*corresponds to the predicted value of environmental quality derived from equation 2, $\varepsilon_{1i}$and ε_{2i} are ε_{3i}perturbation terms.

The first equation concerning the determinants of environmental quality involves a binary qualitative dependent variable that will be estimated using a probit or logit model. Similarly, the second equation involves a qualitative dependent variable estimated by either a probit or logit model. This is a selection equation formed based on the predicted values of the first equation. The dependent variable in the third equation is also a binary variable and is estimated using a logit or probit model .

The system of equations (1-3) is recursive, involving both qualitative dependent variables. When we have two equations with an endogenous input from the first equation entering the second equation as an exogenous variable, a two-step estimation based on the minimum chi-square estimate is used (Rivers and Vuong , 1988). Such a system of recursive equations can be estimated by a multivariate probit model that considers the probable correlation between the pairs of equations. Introducing predicted variables into equations 2 and 3 addresses the endogeneity problem, although bias may still be present due to the introduction of predicted variables. Thus, a conditional mixed process (CMP) technique designed by Roodman (2011), which fully accounts for this bias, is used to jointly estimate the three equations. The advantages of the CMP include its ability to accommodate instrumental variables in seemingly unrelated regressions (SUR) and simultaneous equations, along with its capacity to account for cross-relationships between multiple equations in the model (Roodman , 2011). It allows for control of potential correlation in error terms when estimating multivariate equations because the conditional mixed process estimator is written as an estimator of seemingly unrelated regression models (Maddala , 1986). Thus, this study used the CMP model to analyze the hypothetical direct effects of environmental quality on household health and poverty in Benin.

2.3. Data source

The data used in this article are secondary data from the fifth edition of the Demographic and Health Survey (DHS-V) in Benin (2017-2018). The survey covered a stratified sample of 14,435 households, comprising 6,528 in urban areas (251 clusters) and 7,907 in rural areas (304 clusters). The primary objective was to generate demographic and health indicators from a nationally representative sample of women and men. Subsequently, a household count in each cluster yielded a list of households from

which a sample of 26 households per cluster was drawn, both in urban and rural areas, using systematic sampling with equal probability.

3. Results and discussion

This section presents, firstly, the descriptive statistics on the main variables of interest in our study, namely environmental quality, household health, and household poverty. Secondly, it presents and discusses the results obtained from the econometric estimations.

Table 1 below presents a summary of the descriptive statistics.

Table 1: Descriptive Statistics

Variables	Terms and conditions	Frequencies (%)
Sex	Women	18.54
	Man	81.46
Place of residence	Rural	62.08
	Urban	37.92
Marital status	Bachelor	0.92
	Married	88.34
	Divorced	3.19
	Widower	7.55
Education level	None	69.35
	Primary	15.37
	Secondary	13.85
	Superior	1.43
Mother lives in the household	Yes	98.08
	No	1.92
Migrant status	Not a migrant	86.89
	Returning migrant	13.11

Source: authors, 2022

Table 1 presents the descriptive statistics of the variables used in this article. Specifically, it highlights the relationships between the variables that explain the health status of individuals within the household.

Analysis of this table shows that across our entire sample, 67.99% are anemic, including 84.35% of males and 15.65% of females. Similarly, 41.33% of anemic individuals live in a poor-quality environment, while 30.20% of non-anemic individuals do. Considering place of residence, the majority of anemic individuals live in rural areas (64.08%) compared to urban areas (35.92%). Furthermore, the descriptive statistics also show that 42.32 % of the poor live in an unhealthy environment, compared to 30.96% of the non-poor.

In addition to descriptive statistics, the econometric model was estimated using a conditional mixed process (CMP) technique developed by Roodman (2011). The results of these estimations are presented in Table 2.

Table 2: Estimation Results

Variables	(1) Anemia levels	(2) Poverty index	(3) Environmental Quality Index
Sex	0.196***		
	(0.071)		
Place of residence	0.117	-0.206**	-0.301***
	(0.073)	(0.092)	(0.081)
Migrant status	0.169**	-0.243***	-0.191**
	(0.078)	(0.092)	(0.084)
Mother in household	-0.062	0.202**	0.011
	(0.076)	(0.092)	(0.087)
Environmental Quality Index	1.718***	0.451*	
	(0.055)	(0.232)	
Marital status			-0.019
			(0.099)
Education level			-0.108***
			(0.033)
Constant	-1.038***	0.412**	0.669***
	(0.097)	(0.203)	(0.113)
rho _12	.0455876		
	(.0963192)		
rho _13	-.9880665		
	(.0082074)		
rho _23	-.1341966		
	(.1307496)		
Observations	1,081	1,081	1,081

Robust standard errors in parentheses

***p<0.01, **p<0.05, *p<0.1

Source: authors, 2022

The probability associated with the chi-square statistic (Prob > chi-square = 0.0000) shows that the model is globally significant (see Table 2). Furthermore, the rho statistics from the estimation are all less than 1, demonstrating that the estimates are valid and can therefore be interpreted (Roodman , 2011). Thus, our results show that environmental quality positively influences the health status of households in Benin at the 1% threshold. This result demonstrates that environmental degradation directly or indirectly affects the health of the most disadvantaged. Indeed, the more households live in a degraded environment, the more anemic they are, as an unsanitary environment is a source of various diseases. This result aligns with those of Ebenstein (2012) and Lu et *al.* (2015), who concluded that environmental degradation increases health risks in China. According to these authors, a decline in water quality and an increase in soil pollution exacerbate health risks and healthcare costs for residents of these areas. Along these lines, Jing and Bing (2018) and Wong et *al. (* 2017) assert that environmental degradation, or poor environmental quality, significantly increases healthcare costs. It therefore appears that environmental quality significantly influences the health status of Beninese households. Thus, environmental degradation caused by households can increase the risks of health failure and hospitalization (Arceo et *al.* , 2016; Janke , 2014). Another finding is that migrant status positively influences household health status at the 5 % threshold . This result could be explained by the fact that soil degradation, for example in rural areas, would increase the migration of villagers to urban areas where they carry out income-generating activities that allow them to access adequate health care (Xu and Sylwester, 2016).

The estimation results show a positive and significant effect of the environmental quality index on household poverty. This suggests that improved environmental quality reduces household poverty. Indeed, environmental degradation reduces the volume and productivity of natural capital, thereby diminishing the poor's ability to generate income. Several factors can explain this situation. On the one hand, environmental degradation leads to a reduction in the natural resources that the poor rely on to meet their basic needs. This explanation is supported by Barbier (2010), who argues that household livelihoods can be closely linked to the use of natural resources and ecosystem services. On the other hand, as our results show, environmental degradation affects household health. To cope with illness, they spend their income on healthcare. These healthcare costs drain their resources and, in turn, perpetuate their poverty. However, environmental degradation caused by households can initially stem from their precarious circumstances. This nuance aligns with the conclusion of Rostami and Sadati (2008). They argue that poor households can be considered both victims and perpetrators of environmental degradation (Rostami and Sadati , 2008). Furthermore, Khan et *al.* (2021) assert that poverty underlies environmental degradation, while Duraiappah (1996) demonstrates that environmental degradation inevitably leads to poverty. However, our findings contradict those reported by some authors in the literature. According to Kartiasih and Pribadi (2020), environmental degradation significantly improves the living standards of poor households.

Among the control variables explaining household poverty, it is noted that place of residence and migrant status significantly reduce household poverty in Benin. Indeed, returning from migration improves living standards. This effect of migrant status on poverty is explained by the fact that migration increases household income levels, and therefore, upon returning to their place of origin, households lead a decent life.

Finally, the estimation results reveal that environmental quality is significantly influenced by household place of residence, migrant status, and education level at the 1 % , 5 %, and 1% thresholds, respectively. Indeed, households residing in urban areas degrade the environment less than those in rural areas. Similarly, households returning from migration adopt more environmentally responsible behaviors than others. Regarding education level, the higher the level of education, the less pollution individuals generate. This result demonstrates that education levels give households a certain understanding of the drawbacks of environmental degradation, and, based on this awareness, they adopt behaviors that are more environmentally friendly and thus preserve the environment.

The interaction between environmental quality, poverty, and household health means that a decline in environmental quality not only reduces the poor's direct access to food and fuel but also leads to shortages of these goods in local markets and an increase in their prices. Low income levels then force households to live in unsanitary areas, increasing their vulnerability to disease. Furthermore, poverty prevents them from accessing adequate healthcare, thereby reducing their productivity and diminishing their ability to work and live decently. These poverty traps result in greater dependence of the poor on the environment, thus increasing pressure on the environment and its degradation.

4. Conclusion and policy implications

Environmental preservation for sustainable development has been a global concern for decades. This vision is grounded in the role the environment plays in economic activity and, consequently, in human development. Indeed, the environment provides the resources necessary for the development of human activities but also serves as the receptacle for waste generated by human activities. This waste has a significant impact on human health and, in turn, on household living standards. Therefore, this study aimed to analyze the reciprocal interactions between environmental quality, health, and household poverty in Benin. To achieve this objective, we employed an econometric model estimated using a conditional mixed process (CMP) technique developed by Roodman (2011). The data used are secondary data collected as part of the Benin Demographic and Health Survey (EDSB). Overall, our results show that environmental degradation increases health risks for households that pollute the environment. Similarly, we observe that the environment, which is supposed to provide useful resources for households, exacerbates the precarious situation of individuals when it is destroyed. This result may seem surprising at first glance. However, it is grounded in the fact that by degrading the environment, households not only

become ill and reduce the resources available to meet their needs, but also spend more on healthcare. These expenses deplete their financial resources and further entrench them in precarious circumstances. In light of these results, we can affirm that the poor are the most dependent on the environment, and combating its degradation contributes to curbing poverty. It is crucial that environmental protection policies utilize regulations, incentives, and community mobilization to discourage environmentally harmful behaviors.

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