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Child Stunting and Land Degradation under the Sustainable Development Goals (SDGs): Evidence from 23 Developing Countries

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Abstract

Child stunting and land degradation have received an increasing attention from scholars and practitioners. Both of them are also measured by indicators under the Sustainable Development Goals (SDGs). However, the research on the relationship between child stunting and land degradation is insufficient, especially with the perspective of SDGs. This article uses empirical data of 23 developing countries to explore the relationship between child stunting and land degradation, with the controlling of GDP per capita of the selected countries. Path analysis is added into the traditional OLS method. The results show that land degradation has little impact on child stunting in the selected developing countries, but socioeconomic status affect child stunting significantly. A number of explanations and implications are generated. In particular, several developing countries' strong reliance on food importation may be a reason of why land degradation does not affect child stunting. The interactions between different SDGs are also noted.

Keywords: child stunting, land degradation, path analysis, SDGs

1. Introduction

There is an increasing scientific and practical interest in child growth, in which child stunting is a popular topic (e.g., Rah et al, 2010; Akresh et al, 2011). According to the World Health Organization (WHO, 2015), 'Children are defined as stunted if their height-for-age is more than two standard deviations below the WHO Child Growth Standards median'. Due to its importance in child growth and as a parameter to evaluate national and global achievements in ending hunger and promoting health, it is selected into the framework of Sustainable Development Goals (SDGs) as an indicator (SDG 2.2.1). Several factors are accountable for child stunting, and child stunting caused by land degradation attracts an increasing attention (e.g., Shaw et al, 2020).

Land degradation is defined by the Global Environment Facility (GEF, 2020) under the United Nations Convention to Combat Desertification (UNCCD) as 'the deterioration or loss of the productive capacity of the soils for present and future'. The definition of land degradation by the United Nations Statistics Division (1997) adds in the loss of land's complexity, as well as the possible causes including both natural processes and human activities. However, the definition of land degradation is not a global consensus, as researchers find that it is variable and subject to spatial, temporal, economic, and cultural context (e.g., Warren, 2002). It is widely perceived that land degradation has impact on sustainable development (von Braun et al, 2013), and it is not beyond the conventional knowledge that land degradation is also selected as an SDG indicator (SDG 15.3.1).

There are some existing studies on the relationship between land degradation and child stunting. For example, using Ethiopia as a case study, Endris and Nura (2018) find that a typical sign of land degradation, soil erosion, can affect household food security significantly. Therefore, land degradation would lead to malnutrition and child stunting. The case study adopts the qualitative method 'focus group', based on the authors' familiarity with the case study region. Shaw et al (2020) observe that in India, increasing drought, which is another typical sign of land degradation, is significantly associated with child stunting. This is also because such environment problems including land degradation may result to food security problems. Based on empirical evidence from Bukina Faso, Terre de Hommes (2017) demonstrates that land degradation such as soil depletion may '…forces families to seek alternative sources of income' (Terre de Hommes, 2017, p4). The efforts to seek alternative sources of incomes may also bring negative impact on child stunting, for example, children may need to work for incomes as well, and their parents may need to work far away from children, which reduce the possibility to provide suitable care and nutrition to children and lead to stunting.

In addition to the previous studies which focus on the association between land degradation and child stunting from the angle of food security (a very straightforward angle), other perspectives also exist in the existing literature. For example, Berazneva and Byker (2017) find that in Nigeria, land degradation such as forest loss can have strong impact on children's health. For example, 'one standard deviation of forest loss increases malaria incidence by more than 5 percent in children under five' (Berazneva and Byker, 2017, p516). Ordinary Least Square (OLS) regression is adopted as a core method, which is suitable to the data and context. Negative health conditions are associated with child stunting. With a gender-responsive perspective, UNCCD (2016) demonstrate that land degradation could cause a number of adverse socioeconomic and health outcomes including child stunting, and such outcomes affect girls more. Since females' responsibilities to meet the household's needs including prevent child stunting make them heavily reliant on natural resources (UNCCD, 2016), there is a more urgent need for women to protect their land from degradation.

Existing studies contribute to the knowledge of the relationship between land degradation and child stunting tremendously. Firstly, existing studies provide solid evidence from developing societies to identify the association between land degradation and child stunting, which not only develop good contextual knowledge, but also useful practical implications for sustainable development. Secondly, previous literature offers valuable scientific insights to understand the mechanism of the relationship between land degradation and child stunting. For example, existing studies find that such relationship is possibly created by food security and health issues. Thirdly, empirical evidence are provided by the previous research, which also enrich the knowledge and create opportunities for future studies. Methodologies adopted in existing literature can also be used in appropriate context.

However, weaknesses are also observed in previous literature. Firstly, although existing studies explore the relationship between land degradation and child stunting in developing countries, seldom research link the analysis with the framework of SDGs. Therefore, they are unable to provide specific policy recommendations to support the achieving of SDGs, which are the global consensus and roadmap for the world to achieve a sustainable future (United Nations, 2020). Secondly, although some specific mechanisms of the relationship between land degradation and child stunting are addressed based on country case studies, previous studies seldom provide cross-country comparisons. This reduces the applicability of the knowledge and policy implications generated from existing literature. Thirdly, existing literature linking environment to human development (including child stunting) are still insufficient (e.g., Kanjee and Dobie, 2003), and they do not fully explore the interactions between different SDG indicators (e.g., Liu, 2020). This further reduces the applicability of knowledge as it may lead to the isolation of different dimensions of sustainable development. For example, environmentalists may emphasize environmental protection while invest insufficient resources to human development including child stunting, if they do not pay due attention to human development and its interactions with environmental issues.

Therefore, this article aims to bridge the above-mentioned knowledge gaps. By using data from 23 developing countries (including emerging economies), it is able to generate more cross-national knowledge and implications. Analyzing the relationship between land degradation and child stunting under the framework of SDGs would enable the article to explore more about the interaction between different SDGs (as well as different SDG indicators). This would assist policy-makers to take more balanced and comprehensive approaches when designing sustainable development policies. In addition, by adding other controlling factors and path analysis, this article would provide more in-depth analysis on whether and how land degradation can affect child stunting.

The remaining parts of the article will be arranged as below. The next section outlines the data and methodology. The third section presents the empirical results based on the data and methodology in the previous section. The fourth section further discusses the results with practical implications. The final section concludes the paper with a summary of the article's contribution and limitation.

2. Data and Methodology

2.1 Data

This article uses data of 23 developing and emerging economies (as defined by International Monetary Fund, 2018, p135). These countries are selected not only because of geographical representativeness, but also the availability of data. For example, some other countries may only have land degradation data but not child stunting data, while some countries only have child stunting data without land degradation data. Data unavailability is a challenge of this article and also for global sustainability, which is a reason for itself to be included as an SDG indicator (SDG 17.18.2).

The data of land degradation and child stunting are from the United Nations Database for SDG indicators (United Nations Statistics Division, 2020). Land degradation is measured by the proportion of land that is degraded over total land area (SDG 15.3.1). Child stunting is measured by the proportion of children moderately or severely

stunted (SDG 2.2.1). Both of them are presented as percentages. All land degradation data of these 23 countries are for the year 2015, while child stunting data are for the year 2016 or later.

This article also collects the data of Gross Domestic Product per capita (GDPpc) for the 23 selected countries from the World Bank (2020). The data are all for the year 2016 but has been standardized into current international US Dollars according to purchasing power parity (PPP). This is suitable for the methodology in this article as it involves cross-national analysis. The cleaned raw data are presented below in Table 1. The data are rounded up to 1 decimal point or integral.

Table 1. Data of Child Stunting, Land degradation and GDPpc, selected countries and years

Countries	**Proportion of degraded land in 2015 (%)**	**Proportion of child stunting (%)**	**Year of child stunting data**	**2016 GDPpc (PPP, current international USD)**
Afghanistan	8	38.2	2018	2129
Albania	8	11.3	2017	12003
Bolivia (Plurinational State of)	18	16.1	2016	7500
Central African Republic	13	40.8	2018	851
Colombia	7	12.7	2016	13952
Ethiopia	29	36.8	2019	1879
Gambia	14	13.6	2018	2069
Ghana	14	17.5	2017	4890
Guinea	11	30.3	2018	2079
Kyrgyzstan	24	11.8	2018	4681
Lesotho	20	34.6	2018	3063
Malawi	17	39.0	2018	1025
Malaysia	16	20.7	2016	25546
Mongolia	13	9.4	2018	10742
Niger	7	48.5	2018	1141
Pakistan	5	37.6	2018	4410
Senegal	6	18.8	2019	3076
Thailand	21	10.5	2016	16619
Togo	12	23.8	2017	1454
Turkey	9	6.0	2018	26329
Uzbekistan	29	10.8	2017	6453
Viet Nam	31	23.8	2017	6573
Zambia	7	34.6	2018	3405
Mean (simple)	**14.7**	**23.8**	**---**	**7037.8**

(Data source: United Nations Statistics Division, 2020 and World Bank, 2020)

2.2 Methodology

This article uses OLS as the analytical method plus path analysis. The OLS is an often used standard methodology used to explore the relationship between child stunting and land degradation as illustrated in the previous literature (e.g., Berazneva and Byker 2017; Shaw et al, 2020). This is a suitable method for this article because the data in the article reduce the endogeneity which may exist in OLS. Since the data of land degradation is for the year 2015 and the data for child stunting is for the year 2016 or after, then we can exclude the possibility that child stunting may lead to land degradation (things happened later cannot be the cause of something took place earlier). The GDPpc data is for the year 2016 and therefore will not become a result of child stunting either.

Path analysis usually contributes to explore models where independent variables may influence the dependent variable via different means (e.g., Streiner, 2005). Path analysis is helpful in this article as land degradation may have impact on child stunting in both direct and indirect paths. Firstly, as demonstrated in existing studies, land degradation may directly lead to child stunting as it causes food security problems and health problems (e.g., Endris and Nura, 2018). Secondly, land degradation may cause other general socioeconomic changes such as poverty and child labor (Terre des Hommes, 2017), and then lead to child stunting, which is a more indirect means. GDPpc is a widely-used proxy variable to measure such socioeconomic status. A figure below can illustrate the path analysis based on OLS.

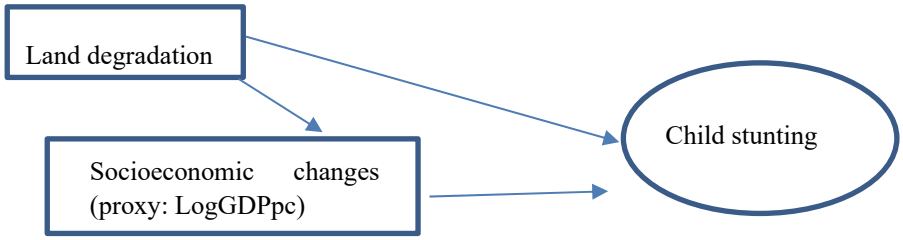

Figure 1. Path Analysis of Land Degradation, Socioeconomic Changes, and Child Stunting

(In this model, there is no arrow pointing at land degradation from child stunting and/or socioeconomic changes, because the data for the latter two variables are later than data for land degradation).

The basic OLS regression is therefore written as below, where GDPpc is presented in logarithm according to standard statistical practice, b_0 is the constant, b_1 and b_2 are coefficients, and u represents the error term.

Child Stunting=b_0+b_1 (Land Degradation) +b_2 (LogGDPpc) +u

The path analysis model is further presented as below, where c_0, d_0, and f_0 are constants, c_1, d_1, and f_1 are coefficients, and e_1, e_2 and e_3 are relevant error terms.

Child Stunting=c_0+c_1 (Land Degradation) +e_1

Child Stunting=d_0+d_1 (LogGDPpc) +e_2

LogGDPpc=f_0+f_1 (Land Degradation) +e_3

3. Results

Table 2 summarizes the results of the coefficients (including both unstandardized and standardized coefficients) and the R Square values.

Table 2. Regression Results

Dependent variable	Coefficients	Standardized coefficients (SD)	R Square
Child Stunting	b_0= 104.7	SDb_1= -0.115	0.579
	b_1= -0.186 (-0.794)	SDb_2= -0.746	
	b_2= -21.48*** (-5.13)		
Child Stunting	c_0= 27.5	SDc_1= -0.157	0.025
	c_1= -0.253 (-0.726)		
Child Stunting	d_0= 102.6	SDd_1= -0.752	0.566
	d_1= -21.66*** (-5.23)		
LogGDPpc	f_0= 3.6	SDf_1= 0.055	0.003
	f_1= 0.003 (0.254)		

Note: numbers in brackets are t statistics; *** symbolize that the coefficient is significant at 0.01 level.

According to the standardized coefficients, the full path model can be illustrated as below in Figure 2:

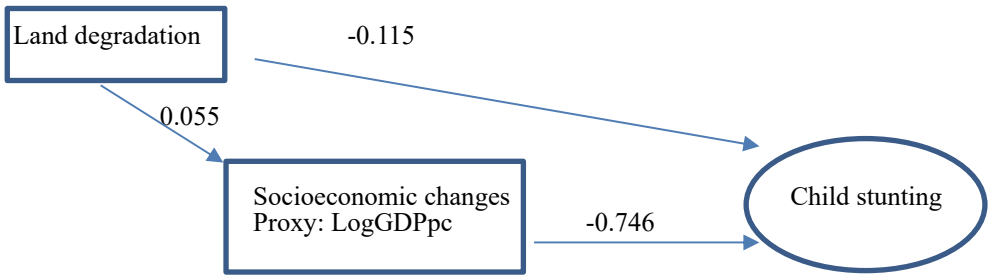

Figure 2. The Full Path Model with Standardized Coefficients

The above results show that land degradation is negatively associated with child stunting. That means, if a country has a higher proportion of degraded land, then that country has a lower proportion of children in stunt. However, this association is not statistically significant. Socioeconomic changes, measured by the GDP per capita of a country, is also negatively associated with the proportion of stunting children. According to the coefficient, a one percentage point increase of GDP per capita can reduce child stunting by near 21.5 percentage points, and the result is statistically significant. The relationship between land degradation and GDP per capita is positive but not significant in terms of statistics. The next section will discuss more on the results.

4. Discussion

The results shown in the previous section, to some extent, are beyond the traditional wisdom and popular knowledge. In particular, the negative and insignificant relationship between land degradation and child stunting contradicts to people's popular belief and some existing literature (e.g., Endris and Nura, 2018).

A possible reason to explain this unconventional finding is that in many developing countries, land and farm activities are not the main sources of incomes (Savadogo et al, 1998), and therefore land degradation is not likely to affect too much on people's income and the growth of children. This could be reflected by the very weak association between land degradation and GDP per capita, a widely selected indicator to measure people's incomes and access to essential living resources.

Another possible reason of this result is that many developing countries, especially some Sub-African countries, strongly rely on importing food to meet domestic demands (e.g., Ewing and Msangi, 2009). Therefore, even though the relationship between land degradation, agricultural activities, and food supply/food security has been widely perceived and demonstrated by existing literature (e.g., Shaw et al, 2020), in some developing countries land degradation will not significantly affect the provision of food to their populations. Thus land degradation may not have a strong influence on child stunting in these countries.

The strong and negative connection between GDP per capita and child stunting is consistent with the existing literature. However, it is surprising to notice that land degradation is positively associated with GDP per capita, although the association is not statistically significant. It means the results suggest that higher proportion of land degradation, although this could reduce the land productivity (e.g., Bojö, 1996), may increase the GDP per capita in a country. This is perhaps because of a large proportion of degraded land may have been converted for other uses which generate higher incomes. For example, degraded grasslands no longer suitable for animal husbandry may be converted into industrial lands on which factories are built, and the factories are likely to generate higher incomes than animal husbandry. This often corresponds to the development mode of countries at early stages of industrialization, which are usually resource-extensive and heavily rely on the sacrifice of environment (e.g., Dhami et al, 2013).

The following implications can be generated from this article. Firstly, the relationship between land degradation and child stunting is complex and should be considered in line with the context of country or region. Although it is widely perceived that land degradation is negative to child growth and may lead to child stunting, it may not always be the situation, especially in developing countries. Secondly, socioeconomic status of a country, as measured by GDP per capita, may have strong impact on child stunting as popularly believed, but its relationship with land degradation may not be easily explored. Although it is consistent with the conventional wisdom that land degradation may cause reduction in socioeconomic status such as loss in agricultural productivity, the situation remains complex in developing countries especially those following a resource-extensive mode of development. The article does not have evidence to support that land degradation may have positive impact on socioeconomic status of a country, but it provides hints that a more comprehensive consideration of environmental

protection, economic development, and population health would be essential, especially in the context of developing countries. This is also important for the SDG framework in which different aspects of sustainable development are to be achieved, and the interactions between different SDGs (including targets and indicators) are observed (e.g., Tosun and Leininger, 2017; Liu, 2020). For policy makers, a proper and more comprehensive consideration of different aspects of development would lead to more balanced development approaches with adequate priorities. This may also reduce the conflicts of interest between different sectors as they were managed separately.

5. Conclusion

This article uses empirical data from 23 developing countries to explore the relationship between child stunting and land degradation with a perspective of SDGs. The cross-country analysis shows that the country context may have significant impact on the relationship between child stunting and land degradation. For example, countries with stronger reliance on food importing may observe less connection between child stunting and land degradation. In addition, it provides evidence that interactions may exist between different SDGs (including targets and indicators). Therefore, more comprehensive and balanced approaches are suggested to policy makers for better addressing such interactions. This is also supported by adding path analysis to explore the complex relationship between child stunting and land degradation, instead of merely using the traditional OLS approach. In short, this article serves as a pioneering research which calls for future studies to explore more about the relationship between child stunting and land degradation with macro perspectives, especially from the angle of sustainable development.

The article is of course not without limitations. As a macro level research, this article cannot add more control variables into the analysis, which may lead to possible disturbances to the results. This is particularly the situation for analysis under the SDG framework, as the interactions between different dimensions of sustainable development exist. Although GDP per capita is a widely-used variable to measure the (change of) socioeconomic status of a country, it is not comprehensive to cover all factors which may affect the relationship between land degradation and child stunting. Future studies may consider incorporating more controlling variables if data permitted.

Data limitation may affect the results of analysis, especially the unconventional finding that land degradation is significantly associated with neither child stunting nor GPD per capita. This is possibly because that the intra-group variations of these developing countries are large. For example, the GDP per capita (after standardized into the current USD according to PPP) varies from USD 851 (Republic of Central Africa) to USD 26, 329 (Turkey). Such sharp variances may affect the results for the cohort with small sample size, which is another data limitation.

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