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An Investigation of the Poverty- Environmental Degradation Nexus: A Case Study of Katonga Basin in Uganda

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Abstract: This study aimed at identifying the poverty/environment nexus in Katonga basin. Our analysis focused on spatial relations between poverty levels and environmental problems at the district level. Our study identified a poverty/environment nexus for cases where poverty levels exhibited strong spatial correlation with two of the four principal environmental problems. Deforestation and wetland degradation were shown to be positively linked with poverty in a spiral web compared to access to clean water, access to toilets, and access to electricity and use of charcoal and firewood that exhibited no significant linkage. We conclude that the welfare of the poor in Katonga basin would be significantly enhanced by close integration of poverty-alleviation and environmental strategies aimed at reducing deforestation and wetlands conversion. A geographic focus on the poorest districts in Katonga basin would appear to be most beneficial.

Key words: Environment degradation, deforestation, poverty, wetland conversion

INTRODUCTION

This study aimed at establishing the causal relationship between poverty and environmental degradation in Katonga basin. Environmental degradation during the past few decades has come to prominence as one of the most important current global issues (Desta, 1999). There is a general consensus that poverty is a major cause of environmental degradation. According to the Bruntland Commission report, poverty is a major cause of environmental problems (World Commission on Environment and Development, 1987). Poverty is one of the greatest threats to the environment (UNDP, 1990). Jalal (1993) also argued that environmental degradation, rapid population growth and stagnant population are closely linked with the fast spread of acute poverty in many Asian countries. In addition, World Bank (1992) stated that poor families who have to meet short-term short term needs mine the natural capital by excessive cutting of trees for firewood and failure to replace soil nutrients.

The Katonga basin has been experiencing some of the most severe problems of agricultural stagnation, resource degradation and deepening poverty found anywhere in East Africa. The major environmental degradation problems include severe erosion, deforestation, conversion of wetlands, low soil fertility, air pollution and water pollution. These problems have been associated with ecological degradation, low crop productivity and poor water quality. In parallel to resource degradation, social welfare conditions in general have deteriorated across the basin, especially over the last two or so decades. The situation mirrors what has been happening in most developed countries, namely simultaneous increase in poverty and environmental degradation (Duraiappah, 1998).

The linkage between poverty and environmental degradation tend to be ignored because our view of the world is traditionally grounded in a practice of splitting it up into manageable components. In an ever more interdependent world by virtue of the relationships, we can no longer afford to continue assuming that linkages are an incidental factor that is too complex to be reflected or operational zed through institutional responses.

Controversy surrounds the relationship between poverty and environmental degradation. One theory postulates that poverty is a direct cause of environmental degradation (Durning, 1989). On the other hand, Somonathan (1991) argues that the poor do not have the resources or the means to cause environmental degradation. This lack of consensus on the relationship between poverty and environmental degradation suggests a nexus governed by a complex web of factors. A nascent pool of literature trying to unravel this complexity has emerged only in the last decade. Although progress has been made in developing frameworks for analyzing the problem it remains a big challenge for researchers to resolve the web and identify the fundamental forces, which govern its complexity to facilitate the formulation of effective policies. This study is response to this

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challenge and focuses on land resource degradation and the link to poverty in the Katonga basin.

The poverty and environment debate is important to us because it provides a framework for understanding intersectoral linkages, and because it helps us define the context and very nature of the individual linkages. In many cases the nexus is locally specific calling for the analysis at basin level rather than at national level. The double challenge of poverty and natural resource degradation are not isolated from one another they are intimately related. What makes these problems so formidable is that poverty and natural resource degradation are not independent problems and cannot be addressed individually. Their solution is simultaneous and requires understanding not of how they are unique, but how they are linked. We may intuitively understand that poverty cause natural resource degradation which in turn affects poverty levels, but the specific details of these interactions are still largely speculative. Understanding the interactions between poverty and environmental degradation is instrumental to strategic thinking. The poverty environmental degradation nexus has not been adequately explored in the Katonga basin. The purpose of this study is to contribute to this knowledge gap by establishing causal relationship between poverty and environmental problems in Katonga basin and to prescribe policy options that will ensure a win-win outcome for all Katonga basin resource users, as well as the environment.

Katonga River originates from Kibale forest and drains directly into lake Victoria at Katonga bay. Katonga River has large wetlands. Most of the area of Katonga river basin is under intensive agriculture with little care of land. The topography of the area is characterized by undulating land and flat topped hills intersected by series of narrow flat-valleys some of them are swampy. The hill ranges form the watersheds from which most streams originate. The soils are predominantly red sandy loamy soils and clay loams with medium to high fertility and productivity (Nkedi-Kizza *et al*., 2001). Soils on the hilltops and foothills are shallow sandy soils mixed with gravel. While soils on gentle slopes of hills are moderately deep reddish silt loam soils. The soils in the wetlands include grey sands whose parent material is alluvium and peat sands and clays formed from papyrus residue and river alluvium.

The catchments has bi-modal rainfall pattern separated by two dry seasons. First rains usually come between mid February and up to the end of May and second rains are from mid August to December. The total annual rainfall ranges between from 1,200 to 1,400 mm. Most of the rains are experienced during the second season. The heavy rains received during the season often cause severe run off that destroy crops grown crops on the foothill. The original vegetation cover of the area belonged to the medium altitude forests but has been greatly changed due to excessive clearance for cultivation, overgrazing and wild fires. Most of the wetland were drained and remaining swampy areas are dominated by swampy vegetation mainly swamp forests, and papyrus, and palm trees. Given the ecological diversity in Katonga basin, there is a lot of wildlife of the wetland kind, for example Situnga, bushbuck, fish, cranes and other wetland birds. The government recently gazetted Katonga game reserve to preserve these rare species of animals and birds.

The Katonga basin is characterized as Southern Medium-High Farm land Agro-ecological zone with montaine coffee-banana-livestock farming system (Mukibi, 2002). The major crops grown are banana, arabica coffee, fruit trees, maize, beans, groundnuts, millet and sweet potatoes. Others crops grown on small scale are cassava, Irish potatoes, field peas, vegetables and yams. A limited number of livestock are kept including; local cows, goats, pigs and chicken. Increasing number of farmers is also keeping graded crosses of cattle and goats. Majority of farmers are small-scale farmers having small land holdings ranging from 0.5 to 1 hectare due to land fragmentation, hilly topography and high population density. Due to land shortage the hillsides with shallow soils are gradually being cultivated for production of annual crops such as millet, maize, beans and sweet potatoes. Cattle are mainly grazed communally on the hilltops during rain seasons and in valleys during the dry season.

High population density, the hilly topography and bad farming methods are the main factors that have contributed to degradation of natural resources in Katonga basin. Uncontrolled clearance of trees and bushes and cultivation on fragile hillsides, overgrazing of hilltops, wild fires, drainage of wetlands and continuous cultivation of the small parcels of land are the major causes of land degradation in the Katonga basin. Most wetlands in Katonga basin are considered as public land. A few of them have been leased to individuals e.g. part of Namaya wetland. The seasonal wetlands are owned under mailo land or leased in some places. Other areas around Katonga basin are under mailo land with leases in some places. Many of the forests surrounding the wetlands are gazetted areas under the central and Local Forest Reserves.

The literature that treats the poverty and environmental degradation nexus usually focuses on the 'vicious circle' between poverty and environmental degradation; the circle is Malthusian in inspiration where farmers pushed by population increase and poverty extend cropping onto fragile marginal lands and degrade them. As a result the yield is reduced and this further impoverishes farmers (Dasgupta and Mäler, 1994; Pearce and Warford, 1993; Mink, 1993). The vicious circle model assumes that poverty is bound up in a web of interactions with environmental degradation in a such way that stress from one of the sources can trap poor households into a vicious circle of increasingly destructive responses. For example poverty contributes to the degradation of the land, if not broken; the vicious circle would lead to ever increasing land degradation.

A new dimension to the link between poverty and environmental degradation was brought out in 1995 when Reardon and Vosti introduced the concept of 'investment poverty' and related the same to other measures of poverty (Reardon and Vosti, 1995). They concluded that the links between poverty and environment in a given setting depend on the level, distribution and type of poverty and environmental problems.

The downward spiral hypothesis maintains that poor people and environmental damage are often caught in a downward spiral. Past resource degradation deepens today's poverty, while today's poverty makes it very difficult to care for or restore the agricultural base, to find alternatives to deforestation to prevent desertification, to control erosion and to replenish soil nutrients. People in poverty are forced to deplete resources to survive, and this degradation of environment further impoverishes people (Ostrom *et al.*, 1999). Poverty-constrained options may induce the poor to deplete resources at rates that are incompatible with long-term sustainability (Holden *et al.*, 1996). In such cases, degraded resources precipitate a "downward spiral," by further reducing the income of the poor (Durning, 1989; Pearce and Warford, 1993). Rapid population growth, coupled with insufficient means or incentives to intensify production, may induce overexploitation of fragile lands on steep hillsides, or invasion of areas that governments are attempting to protect for environmental reasons. Again, a downward spiral can ensue (World Bank, 1992)

Norman (1993) argues that the poor feel compelled to do what they often recognize is harmful to their own long-term interest yet they feel they have no alternative by virtue of their absolute poverty. Hence, these farmers are often the principal source of deforestation, desertification, and soil erosion, together with attendant problems such as watershed degradation, disruption of hydrological systems and mass extinction of species. The poor have no capital to invest in agricultural adaptations to make their farming less destructive environmentally and thus perpetuating the poverty of many farmers.

According to Lopez (1992) a common hypothesis is that the major source of forest, biomass and soil degradation is poverty. The poor tend to be highly dependant on natural environment for their survival. According to this hypothesis, the rural poor who make up for more than two thirds of the worlds poor according to World Bank (1992), have no option but to consume the environmental resources to survive, for example, slash and burn practices, cutting trees for fuel wood, and unsustainable cultivation practices. In this view, environmental destruction and poverty reinforce each other.

What does the empirical evidence suggest about the actual prevalence and importance of the poverty-environment nexus? Empirical evidence on the prevalence and importance of the poverty/environment nexus is sparse because the requisite data are often difficult to obtain in developing countries. Dasgupta (2003) use newly available spatial and survey data to investigate the spatial dimension of the nexus in Cambodia, and Lao People's Democratic Republic. The data enable the authors to quantify several environmental problems at the district and provincial level. In a parallel exercise, they map the provincial distribution of poor households. Merging the geographic information on poverty and the environment, the authors search for the nexus using geo-referenced indicator maps and statistical analysis. The results suggest that the nexus is country-specific: geographical, historical, and institutional factors may all play important roles in determining the relative importance of poverty and environment links in different contexts. Joint implementation of poverty and environment strategies may be cost-effective for some environmental problems, but independent implementation may be preferable in many cases as well.

Regression results by Okwi *et al.* (2006) suggest a certain degree of spatial correlation between poverty and some of the biophysical variables in Uganda. The proportion of land under woodland, depleted tropical high forests, subsistence and commercial farm found to be the most important biomass spatially associated with rural poverty in central and Western Uganda rural stratum. Evidence by Okwi *et al.* (2006) show that households that use positive amounts of natural resources, dependence on natural resources, follows a U-shaped relationship with income, declining at first, but then increasing. This finding contrasted previous studies that resource dependence, defined as the fraction of total income derived from common pool resources, strongly decreases with income.

A study by Rozelle *et al.* (1997) on the relationship among population, poverty and environmental degradation in China examined the impact that each had on the China's land, water, forest and pasture resources. They found the government policy to be ineffective in controlling rural resource degradation primarily because of its limited resource and poorly trained personnel. According to the report of Government of China, Ministry of Agriculture, rapidly expanding township and village enterprise sector have been the major sources of water pollution in China (GOC, 1991). Next to industrial effluents, agricultural chemical runoff and leaching are also causing serious water pollution (Mei, 1992). Recent participatory poverty assessments, conducted in 14 developing countries of Asia, Africa, and Latin America, reveal a common perception by the poor that environmental quality is an important determinant of their health, earning capacity, security, energy supplies and housing quality (Brocklesby and Hinshelwood, 2001).

Rural studies commonly observe that poor people's economic dependence on natural resources makes them particularly vulnerable to environmental degradation (Cavendish, 1999; Cavendish 2000; Kepe, 1999). Other studies have assessed the health damage suffered by poor households that are directly exposed to pollution of the air, water and land (Akbar and Lvovsky, 2000; Mink, 1993; Songsore and McGranahan, 1993) In addition, environmental disasters and environment-related conflicts may have regressive impacts because the poor are least capable of coping with their effects (Myers and Kent, 1995).

In some cases, poor households themselves may increase environmental degradation. Some studies have established a link between poverty and consumption of wood fuel, and at least one credible study has established the relationship between indoor combustion and health (Ezzati and Kammen, 2001). However, the research also suggests the importance of intervening variables such as cooking practices (indoor versus outdoor) and fuel choice (e.g., charcoal emits far fewer fine particles than wood). Children die of waterborne disease at higher rates in poor households, but again, research points to the significance of intervening variables such as water source quality and mothers' education (Merick, 1985).

The above discussion on the various studies conducted worldwide reveal that there is a two-way linkage between poverty and environmental degradation. The existing literature suggests that the strength of poverty-environment linkages may be affected by factors as diverse as economic policies, resource prices, local institutions, property rights, entitlements to natural resources, and gender relations (Arnold and Bird, 1999; Dasgupta and Maler, 1994). By implication, the relative strength of links between poverty and environment may be very context-specific (Ekbom and Bojö, 1999).

MATERIALS AND METHODS

This study was carried out in 2008, at Makerere University, Uganda. We analyzed the poverty/ environmental degradation nexus by examining spatial relations between poverty at the district levels in Katonga basin with environmental degradation indicators to establish any existing linkage. Accordingly, we indexed districts by the percentage of inhabitants who fall below the national poverty line (using headcount index) and linked those poverty indices with environmental degradation indicators. We considered four critical environmental problems related to natural resource degradation, i.e., deforestation, wetland conversion, indoor air pollution, and water pollution.

Deforestation: The rate of deforestation serves as a proxy for the loss of critical ecosystems and biodiversity, as well as increased risk of soil erosion in steeply-sloped areas. To test for a poverty/environment nexus in this context, we assessed the spatial correlation of poverty and deforestation using graphical scatter plots and regressions. In the regression analysis, we also included overall population density to capture the population pressure on deforestation.

Indoor air pollution: Recent research has suggested that indoor air pollution from wood fuels is a major cause of respiratory disease in developing countries. Access to cleaner and efficient energy services is a critical element for overcoming poverty and also for ensuring environmental sustainability. We used regression analysis to test whether districts with high percentages of households living in absolute poverty are significantly greater users of charcoal and wood than districts with higher-income households. A positive finding would support the case for a joint environment/poverty strategy. Reducing indoor air pollution would differentially improve the welfare of the poor, and reducing poverty would reduce health damage from indoor air pollution.

Water pollution: Safe water and adequate sanitation are critical determinants of health status, particularly for children. Ingestion of coliform bacteria from contaminated drinking water is a prime cause of diarrheal disease, which is in turn a major cause of infant mortality in developing countries. A poverty/environment nexus exists if the affected households are disproportionately poor. We use scatter plots and regressions to test for this possibility.

Wetland conversion: Wetlands conversion is done to create space for cultivation and grazing of cattle resulting into loss of biodiversity and a decreased filtering effect on the water entering the lake. A poverty/environment nexus exists if the affected households are disproportionately poor. We use scatter plots and regressions to test for this possibility. We test for a poverty/environment nexus by assessing the spatial correlation between poverty and wetlands conversion.

Hypotheses: We postulated that it is poverty, which causes environmental degradation in Katonga basin. We also postulated that it is environmental degradation, which is a major factor causing poverty. If the first and second hypotheses hold, this can be interpreted as a feedback in which case we get the downward spiral illustrated by Durning (1989). From a spatial perspective, a potential

Table 1: Determinants of environmental problems

	Dependent variables					
	Deforestation level		Wetland conversion ratio		Charcoal and fuel wood usage	
Poverty index	11.13(3.3)**	11.62(3.69)***	0.111(2.57)*	0.109(2.84)**	0.0287(1.26)	0.040(1.11)
Population density	- 0.026(-.05)		0.0016(.26)		- 0.00999(-2.97)**	
Constant	- 453.80(-2.13)*	- 458.73(-2.69)**	- 4.73(-1.76)	- 4.43(-2.04)*	97.95(69.2)***	96.08(47.3)***
R^2	0.73	0.73	0.62	0.62	0.74	0.20

***, **, *: Indicate statistical significance at 1, 5 and 10% levels, respectively. Values in brackets are robust t-statistics

poverty/environment nexus exists if environmental damage is significant in high-poverty districts.

RESULTS AND DISCUSSION

Deforestation: Our regression results (Table 1) confirm the positive relationship between poverty levels and forest clearance suggesting that poverty is a major determinant of deforestation. After controlling for population density, the relationship between poverty and deforestation does not change. Deforestation is also shown by our regression results to be one of the major determinants of poverty levels, that is an increase in deforestation leads to an increase in poverty levels. This finding is consistent with the findings by Okwi *et al.* (2006) and Dasgupta (2003). This finding is also consistent with the downward spiral hypothesis that maintains that poor people and environmental damage are often caught in a downward spiral. People in poverty are forced to deplete resources to survive, and this degradation of environment further impoverishes people (Ostrom *et al.*, 1999). Poverty-constrained options may induce the poor to deplete resources at rates that are incompatible with long-term sustainability (Holden *et al.*, 1996). In such cases, degraded resources precipitate a "downward spiral," by further reducing the income of the poor (Durning, 1989; Pearce and Warford, 1993). In summary, our results support the downward spiral hypothesis and by implication, alleviating absolute poverty would be likely to reduce poverty-induced deforestation. Deforestation is therefore an important poverty/environment nexus issue in Katonga basin.

Wetlands degradation: Table 1 and 2 provide evidence on the relationship between poverty and wetlands degradation. Our regression results also show that poverty as a major significant positive determinant of wetlands conversion. A similarly-positive, but somewhat weaker, relationship exists when the determinants of wetlands conversion are analyzed. We conclude that poverty, and wetlands conversions constitute another important poverty/environment nexus in Katonga basin.

Water pollution: Table 4 suggests a loose and insignificant spatial correlation between poverty and lack of access to clean water of -0.25. Regression analysis (Table 2 and 3) indicates an insignificant relationship between poverty and access to water in Katonga basin. Similar results were also obtained for access to toilets variable. We conclude that access to clean water and access to toilets are not a poverty/environment nexus issue of great importance in Katonga basin.

Table 2: Determinants of poverty

	Dependent variable: poverty index	
Deforestation	0.0504(4.00)***	0.0468(3.35)***
Wetlands conversion	3.367(2.87)**	3.137(2.21)
Charcoal usage	0.575(.33)	
Access to water	- 0.109(-1.20)	
Access to electricity		- 0.34(-.74)
Access to toilets		0.176(.77)
Constant	- 10.697(-.06)	31.134(2.06)
R^2	0.96	0.95

***, **, *: Iindicate statistical significance at 1, 5 and 10% levels, respectively. Values in brackets are robust t-statistics

Indoor air pollution: Table 4 suggests a loose and insignificant spatial correlation between poverty and use of charcoal as the major source of energy of .60. Regression analysis (Table 2 and 3) also indicates an insignificant relationship between poverty and use of charcoal in Katonga basin. Similar results were also obtained for access to electricity variable. We conclude that access to electricity and use of charcoal as the major source of energy are not a poverty/environment nexus issue of great importance in Katonga basin. However this result should not be construed as lack of relationship between the two without conducting further studies based on spatially disaggregated data.

CONCLUSION

This study aimed at identifying the poverty/environment nexus in Katonga basin. Our analysis focused on spatial relations between poverty levels and environmental problems at the district levels. Our study identified a poverty/environment nexus for cases where poverty levels exhibited strong spatial correlation with two of the four principal environmental problems. Deforestation and wetland degradation were shown to be positively linked with poverty in a spiral web compared access to clean water, access to toilets, access to electricity and use of charcoal and firewood that had no significant linkage.

Table 3: Determinants of environmental problems

	Dependent variables					
	Access to water		Access to electricity		Access to toilets	
Poverty index	0.0408(.06)	- 0.0698(-.1)	- 0.0134(-.27)	- 0.077(-.44)	0.412(1.36)	0.322(.90)
Population density	0.0988(.92)		0.057(7.71)***		0.805(1.79)	
Constant	21.637(.48)	40.14(1.01)	- 3.609(-1.16)	7.086(.71)	39.13(2.63)**	54.19(2.67)**
R^2	0.18	0.0019	0.93	0.04	0.52	0.14

***, **, *: Indicate statistical significance at 1, 5 and 10% levels, respectively. Values in brackets are robust t-statistics

Table 4: Partial correlation coefficients with poverty index

	Correlation	Significance
Deforestation	0.90	0.014
Wetlands conversion	0.86	0.030
Charcoal usage	0.60	0.205
Access to electricity	0.49	0.326
Access to water	- 0.25	0.630
Access to toilets	0.44	0.390

We conclude that the poor in Katonga basin would benefit most strongly from programs that jointly address poverty and forest and wetlands degradation since these environmental problems exhibit a spatial correlation with poverty. The welfare of the poor in Katonga basin would be significantly enhanced by close integration of poverty-alleviation and environmental strategies aimed at reducing deforestation and wetlands conversion. A geographic focus on the poorest districts in Katonga basin would appear to be most beneficial. There is need for further studies to analyze the environmental and poverty nexus in Katonga basin using spatially disaggregated data.

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