Popul Environ (2008) 30:48–72
DOI 10.1007/s11111-008-0073-x

ORIGINAL PAPER

Women, non-governmental organizations, and deforestation: a cross-national study

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Published online: 12 November 2008

Abstract There have been several cross-national studies published in the world polity theoretical tradition that find a strong correlation between nations with high levels of environmental nongovernmental organizations (NGOs) and low levels of various forms of environmental degradation. However, these studies neglect the role that women's NGOs potentially play in this process. We seek to address this gap by conducting a cross-national study of the association between women's NGOs and deforestation. We examine this relationship because deforestation often translates into increased household labor, loss of income, and impaired health for women and, as a result, women's non-governmental organizations have become increasingly involved in dealing with these problems often by protecting forests. We use data from a sample of 61 nations for the period of 1990–2005. We find substantial support for world polity theory that both high levels of women's and environmental NGOs per capita are associated with lower rates of deforestation. We also find that high levels of debt service and structural adjustment are correlated with higher rates of forest loss. We conclude with a discussion of findings, policy implications, and possible future research directions.

Keywords Deforestation · Women · Non-governmental organizations · Cross-national

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Introduction

The world polity theoretical tradition holds that international organizations play an important role in constituting and reinforcing world cultural norms (e.g., Schofer and Hironaka 2005; Schofer and Meyer 2005; Frank et al. 2000; Meyer et al. 1998). In this regard, Meyer et al. (1997) describe the existence of the "world environmental regime," composed of non-governmental organizations (NGOs) and inter-governmental organizations (IGOs) that serve as carriers of world culture, which diffuse progressive global models that are adopted by other actors. Of particular relevance to our study is the role NGOs play in this process and the potentially beneficial impacts for the natural environment that may emerge as environmental NGOs (e.g., Greenpeace, World Wildlife Fund, and Nature Conservancy) fund conservation initiatives, support social movement activity, and are involved in the negotiations of environmental treaties.

In fact, a number of cross-national studies published in the world polity tradition demonstrates that environmental NGOs are associated with improvements in environmental conditions of a host nation. For example, Bradshaw and Schafer (2000) find that higher levels of environmental NGOs are correlated with higher levels of access to safe drinking water in a nation. Similarly, Shandra et al. (2008a), Shandra (2007a, b) find that nations with higher levels of environmental NGOs are correlated with lower rates of deforestation. Schofer and Hironaka (2005) find a similar association between environmental NGOs and carbon dioxide emissions. Frank et al. (2000) find that higher levels of environmental NGOs are associated with more protected land area, the adoption of environmental impact assessment laws, and establishment of national environmental protection agencies. Finally, Frank (1999) determines that higher levels of environmental NGOs are related to a greater probability of ratifying environmental treaties.

Yet, largely absent from this cross-national research is awareness of, or attention to, the relationship between gender, gender expectations, and environmental degradation especially deforestation. This is somewhat surprising for a few reasons. First, in many cultural contexts, gender expectations shape environmental effects, with women often being uniquely and disproportionately affected by environmental degradation (e.g., Rocheleau et al. 1996). For instance, many women are responsible for natural resource-based household tasks, including the collection of fuelwood for cooking (Rawat 2004). Women also use fuelwood to prepare alcohol, pottery, and food in order to supplement their incomes in many parts of the developing world (Joekes et al. 1996). As resource availability decreases from deforestation, such alternative livelihood activities become less viable and may be abandoned altogether. Further, deforestation often translates into increased household labor since women have to travel greater distances to collect wood (e.g., Koda 2004). Second, Rudel (2005), Guha (2000), and Shiva (1988), among others, describe how women, especially through participation in NGOs, have become increasingly involved in dealing with deforestation's impacts (i.e., increased required labor, loss of income, and impaired health) often by protecting forests. Third, Norgaard and York (2005) find in their cross-national study that higher levels of women's political participation are correlated with higher levels of environmental treaty ratification.

They also call for additional cross-national research that considers how gender may affect other political and environmental outcomes.

Thus, we seek to address this gap in the cross-national literature by expanding current research in the world polity tradition regarding the potentially beneficial impact that NGOs have on the natural environment. In particular, we conduct a cross-national analysis that demonstrates the importance of considering not only how the presence of environmental NGOs is associated with deforestation in general, but also the particular role played by women's NGOs or NGOs with an *explicit* focus on issues related to women, environment, and development (e.g., Women's Environment and Development Organization). We now turn to a review of why social scientists might consider the gender dimensions within cross-national environmental research—including a discussion of why we might anticipate that women's NGOs may decrease deforestation. We then briefly describe our independent variables and provide rationales for their inclusion. We conclude with a discussion of findings, policy implications, and possible future research directions.

Why consider gender within cross-national research on forests?

According to feminist political ecology, women are uniquely and disproportionately affected by environmental degradation because of gender divisions with regard to labor, land access, and forest resources (e.g., fuelwood, leaves, fruits, seeds, etc.) (Rocheleau et al. 1996). Yet there is considerable debate regarding why women are uniquely and disproportionately affected by environmental problems. On the one hand, Mies and Shiva (1993) put forth an "essentialist" approach that suggests women's intimate connection to the environment is related to their reproductive role. In other words, the ability of women to reproduce and rear children parallels the broader ability of the environment to reproduce and create life (Shiva 1988). On the other hand, Jackson (1993) and Agarwal (1992) adopt a "materialist" approach that posits the intimate relationship between women and nature is due to the material needs and position of women in society. Put differently, it is largely the result of women having to provide natural resources for the household (e.g., fuelwood for cooking and cleaning) and depending upon them for a livelihood (e.g., selling handicrafts) (Agarwal 1992). Regardless, both perspectives suggest that rural women in less developed settings, many of whom depend upon natural resources for provision of household food, fuel, and income, may be adversely affected by environmental degradation especially deforestation in several ways.

First, women are often disproportionately responsible for household labor in many less developed settings (Buckingham-Hatfield 2000). Such labor includes effort in acquisition of necessary household resources (Hunter 2005) and, therefore, resource degradation, including deforestation, can dramatically increase the working day for women in poor nations (Koda 2004). As forests are cleared, women must walk further to collect necessary resources such as fuelwood (Agarwal 1992). For example, Tinker (1984) finds that during the 1970s women in Nepal were able to collect fuelwood in 2 h. However, just ten years later, fuelwood collection took an entire day and involved walking through difficult terrain. Agarwal (1992) describes a situation in the Sudan where the time taken by women to collect

firewood has increased fourfold during a 10-year period. Koda (2004) identifies a similar situation in Tanzania where women spend double the time collecting fuelwood as compared to five years prior. According to Rawat (2004) and Buckingham-Hatfield (2000), it is not unusual for women in India to spend five hours daily collecting firewood although traditionally this chore was done weekly. The difficulties inherent in resource collection in degraded settings are exacerbated for women in refugee camps given the often high population densities (Buckingham-Hatfield 2000). Black (1986) estimates that women in such camps spend an extra hour and a half on fuelwood collection—translating into an additional 20,000 h of work annually for refugee women.

Households often shift to alternative cooking fuels, such as cattle dung and crop residues, when forests disappear (Maskey 2005; Cecelski 1985), and this shift can affect agricultural productivity (Cecelski 1987). Dankelman and Davidson (1988) estimate that every ton of cattle dung used as fuel results in a loss of more than one hundred pounds of food grain since the fertilizer use of dung and crop residues enhances agricultural yield. On average, 400 million tons of cattle dung and crop residue are used annually as fuel, translating into a substantial loss of agricultural productivity. Of course, in many settings, agricultural productivity is also constrained by soil erosion and desertification brought by deforestation (Rudel 2005). Because women are responsible for 8% of subsistence agriculture in many less developed settings (Dankelman and Davidson 1988), loss of agricultural productivity increases labor required to reap sufficient harvest and/or seek alternatives (Agarwal 1992).

Second, deforestation may lessen opportunities for women to pursue resource-based alternative livelihoods (Blackden and Wodon 2006; Katz and Monk 1993). To some extent, this reflects additional time spent on household tasks (e.g., gathering fuelwood) as noted above, although forests provide the raw materials to make handicrafts, which are often sold for an income (Giannecchini et al. 2007; Dovie et al. 2004; Joekes et al. 1996). Additionally, wood fuels the preparation of food and alcohol for sale (Katz and Monk 1993). As resource availability decreases from deforestation, such alternative livelihood activities become less viable and may be abandoned altogether (Bryant and Bailey 1997). For instance, Dankelman and Davidson (1988) note the price of wood in Burkina Faso increased nearly 28% annually from 1977 to 1981. However, the price of dolo beer, which women produce using large amounts of fuelwood, rose more slowly, resulting in income loss for beer-producing women. Similarly, Ardaydio-Schandorf (1984) finds that the incomes of women producing charcoal in Ghana declined as forests were cleared to expand export agriculture.

Third, deforestation can affect women's health (Huyun et al. 2005). We note previously that a shift to alternative fuels often occurs when forest availability declines. However, the smoke from burning dung and crop residues is more toxic than fuelwood (Katz and Monk 1993), and has been associated with acute lower respiratory infections, chronic obstructive pulmonary disease, and lung cancer in women in poor nations (Dankelman and Davidson 1988). This problem is exacerbated since fires fueled by dung or crop residues require continuous tending (Buckingham-Hatfield 2000). Another health impact relates to wood collection

specifically—fuel-collecting women often carry loads up to 75 pounds on their heads (Anker 1997), far in excess of the limits set by the International Labor Organization Maximum Weight Convention. As wood availability lessens, collection distances increase and these loads have been linked to spine damage, pregnancy complications, and maternal mortality (Anker 1997).

Fuelwood scarcity may also translate into the preparation of less food and/or less nutritious food (Buckingham-Hatfield 2000). For example, Agarwal (1992) finds that, in Bangladesh, there has been a shift from daily cooking of two meals to only one because of fuelwood shortages. Dankelman and Davidson (1988) describe a shift from the staple diet of beans to other less fuel intensive and nutritious foods in Mexico. These dietary shifts have important health implications for women, since often eating last (Santow 1995), these dietary shortages may result in malnutrition and anemia, which increase susceptibility to illness (Dyches and Rushing 1996) and pregnancy complications (Shen and Williamson 1999).

In sum, many women throughout the developing world may be adversely affected by deforestation in a number of ways. These include increased household labor, loss of an ability to generate an income, and impaired health. As a result, many women's NGOs have become increasingly active in helping to solve these problems often by protecting forests.

World polity theory: considering women's non-governmental organizations

As noted previously, the world polity theoretical tradition hold that international organizations play an important role in constituting and reinforcing world cultural norms (e.g., Schofer and Hironaka 2005; Schofer and Meyer 2005; Frank et al. 2000; Meyer et al. 1998). From this perspective, international NGOs are characterized as carriers of world culture who diffuse progressive global models that are adopted by other actors (Boli and Thomas 1999). Of course, numerous critiques have been put forth that call into question world polity theory's ideas regarding the beneficial impact of NGOs on forests. For instance, Livernash (1992) argues that environmental NGOs may have not impact on deforestation because their projects are too limited in scale and narrow in geographical focus. Lewis (2000) argues that NGOs are affected by laws governing the nations in which the NGOs operate. In particular, NGOs are often only tolerated if they meet with the approval of government officials in repressive nations (Clark 1991). Moreover, Chapin (2004) suggests that NGOs may be unwilling to criticize the environmental records of corporations and multilateral institutions that provide them funding. Finally, Powell and Seddon (1997) maintain that environmental NGOs impede local institutional development, exacerbate information dependency, and further remove the local of decision making from the stakeholders. For a detailed discussion of the limits and challenges NGOs face in their efforts to protect the natural environment especially forests, see Shandra (2007b) or Bryant and Bailey (1997).

Despite this debate, most cross-national research shows a beneficial relationship between environmental NGO presence within a nation and deforestation (e.g., Shandra et al. 2008a; Shandra 2007a; Schofer and Hironaka 2005). These studies

show, all else equal, nations with higher levels of environmental NGOs tend to have lower rates of deforestation. However, all of these studies neglect the potentially beneficial impact that women's NGOs may play in protecting forests. This is somewhat surprising since gender expectations shape the burdens of deforestation and women have become increasingly active in protecting forests (Maatthai 2006a; Rudel 2005; Guha 2000; Shiva 1988). Thus, we now turn to a discussion of the different tactics women's NGOs use to help reduce deforestation.

First, women's NGOs often provide financial and technical assistance at the local level supporting, for example, agroforestry projects, demarcating parks, and/or planting trees (Bryant and Bailey 1997). As an example, as chair of the National Council of Women of Kenya, Wangari Maatthai launched a national reforestation effort in 1977. The campaign seeks to train women in cultivating seedlings and raising tree crops (Maatthai 2006a). The seedlings are sold back to the program and redistributed at no charge for planting elsewhere. And, since 1977, over 30 million trees have been planted and 80,000 women employed in nurseries (Maatthai 2006b). This "Greenbelt Movement" also conducts educational programs regarding women's rights, civic involvement, and the environment. In 2004, Wangari Maatthai was awarded the Nobel Peace Prize for her work and similar programs have been launched elsewhere in Sub-Saharan Africa (Maatthai 2006b).

Second, women's NGOs (e.g., Women's Environment and Development Organization) help to stimulate social movement activity within a nation (Keck and Sikkink 1998). These social movement activities may include coordinating protests, organizing consumer boycotts, or supporting letter writing campaigns (Bryant and Bailey 1997). The social movement activity tends to propagate environmentalism within a nation, which pressures governments, corporations, and multilateral lending institutions (Keck and Sikkink 1998). Thus, governments are "squeezed" by international NGOs from "above" and local social movements from "below" to deal with environmental problems like deforestation (Schofer and Hironaka 2005). A useful example comes from Latin America. Grassroots Organizations Operating Together in Sisterhood helps women organize at the local level to increase their participation in development project planning and decision-making in Peru, Brazil, Columbia, and Venezuela. The organization serves as an information source for women on lobbying (Grassroots Organizations Operating Together in Sisterhood 2007). Similarly, in several Asian, African, and Latin American nations, the Women's Environment and Development Organization monitors the activities of corporations engaged in extractive industries (e.g., logging, mining, and agriculture) (Women's Environment Development Organization 2007) with the objective of deterring companies from violating legal obligations through the potential of media exposure and additional social activism (e.g., consumer boycotts) (Newell 2000).

Third, women's NGOs conduct research, set standards, write codes of conduct, and create technical guidelines to improve the environmental performance of corporations and multilateral financial institutions (Boli and Thomas 1999). The International Gender and Trade Network, for example, provides technical information to governments, IGOs, and NGOs regarding gendered impacts of trade (e.g., structural adjustment increases deforestation by boosting primary

product exports, which force many women to walk farther to gather fuelwood) (Williams 2007). Similarly, Wachira (2007) highlights the impact of environmental degradation from logging, mining, and export agriculture on women's health, income, and household labor. Such reports also suggest potential solutions including tree planting and demarcation of extractive reserves (Wachira 2007). Such research has been used by other NGOs to lobby for changes at the United Nations, World Bank, and International Monetary Fund (Keck and Sikkink 1998). Further, local social movement and concerned citizens may use these research reports to pressure their governments to enact changes to their environmental practices (Barbosa 2001).

Fourth, NGOs exert pressure over governments by shaping the language of international environmental treaties (Frank 1999). Accordingly, they can influence the normative context of global institutions. Environmental NGOs play a large part in helping to write environmental treaties (Frank 1999). However, women's NGOs also play an important role in this process (Keck and Sikkink 1998). For example, women's NGOs (e.g., Women's Environment and Development Organization) were largely involved in the negotiation of language for the United Nations Treaty to Combat Desertification and United Nations Convention on Biological Diversity (United Nations 2004). As a result, both treaties acknowledge the importance of gender in shaping the management of natural resources, especially forests, and endorse equal participation, across gender, in the implementation of both treaties (United Nations 2004).

After shaping treaty language, environmental NGOs have traditionally monitored compliance in the absence of resources and formal enforcement mechanisms (Keck and Sikkink 1998). Thus, environmental NGOs are in the position of pointing out failures and hypocrisies of nations that ratify treaties (Frank 1999), while also bringing attention to nations not ratifying. In both instances, heightened attention can put pressure on governments to adapt to international norms (Hafner-Burton and Tsutsui 2005). Women's NGOs have also become increasingly involved in the monitoring process (Buckingham-Hatfield 2000). They, however, tend to, focus their monitoring activities on nations that are not adequately involving women in the management of natural resources especially forests, key provisions of the United Nations Convention to Combat Desertification and the Convention on Biological Diversity and an aspect often overlooked by environmental NGOs (Buckingham-Hatfield 2000). As a result of public scrutiny from women's NGOs, for example, Senegal established a national forum to increase women's involvement in the implementation of the national action plan on desertification (United Nations 2004).

In sum, this review suggests that women's NGOs often engage in a wide array of material, ideological, education, and political activities that, in the aggregate, possess the potential power to serve women's interests by shaping environmental policy. We now turn to an empirical analysis that tests this hypothesis. Note too that it is incumbent upon us to test this hypothesis in the context of previous published cross-national models of deforestation. Therefore, we now turn to a brief discussion of other theoretically relevant independent variables that are included in our analysis.

Methodology

Nations included

We include nations in Latin America, Caribbean, Africa, Asia, and Europe not classified as high income according to the World Bank's (2003) income quartile classification scheme.[1] We do not include nations formed following the collapse of the Soviet Union simply because there are no data for them in 1990. We exclude high income nations for a couple of reasons. First, the adverse effects of deforestation are mainly felt by women in developing nations (Dankelman and Davidson 1988). Second, rich nations are not the recipient of structural adjustment loans, an independent variable we include in the models, so they are also excluded from the analysis—see below for a discussion of structural adjustment. These considerations ultimately yield a sample of 61 nations for which complete data are available. We follow the standard practice of removing and reporting any influential cases from the analysis (Jorgenson 2003) and, in particular, we remove Indonesia from the analysis because it is an influential case based upon Cooks D statistics.

Dependent variable

Deforestation

The dependent variable for our analysis is the average annual percentage change in natural forest area from 1990 to 2005 as obtained through the Food and Agriculture Organization (FAO 2005). Deforestation is signified by a positive value and means there is a loss of forest area. A natural forest consists only of native forest species with the possible exception of small areas of natural regeneration or assisted natural regeneration. In other words, the natural forest measure excludes forest plantations, which are areas established through planting or seeding usually of one or two types of trees (FAO 2005). Most cross-national research (e.g., Burns et al. 2003; Jorgenson 2006; Shandra 2007a) examines the average annual percentage change in *total* forest area, which includes natural forest areas and forest plantations. Forest plantations are used for growing a relative homogeneity of species primarily for commercial purposes (World Resources Institute 2005). As such, we use *natural* forest area data since we are interested in the potential effects of women's non-governmental organization in preventing the loss of forests that not already being intensively managed for commercial purposes. We note some of the potential limitations of this data below. We also provide descriptive statistics and bivariate correlations for all the variables in Table 1.

[1] The following nations are included in the analysis: Albania, Algeria, Angola, Argentina, Bangladesh, Bolivia, Brazil, Bulgaria, Burkina Faso, Central African Republic, Chad, Chile, China, Columbia, Congo, Costa Rica, Ecuador, El Salvador, Ethiopia, Gambia, Ghana, Guatemala, Guinea, Guinea-Bissau, Honduras, Hungary, India, Jamaica, Kenya, Lesotho, Madagascar, Malawi, Malaysia, Mexico, Mongolia, Mozambique, Nepal, Nicaragua, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Romania, Rwanda, Senegal, Sierra Leone, South Africa, Sri Lanka, Swaziland, Tanzania, Thailand, Togo, Trinidad, Uganda, Uruguay, Zambia, and Zimbabwe.

Table 1 Descriptive statistics and bivariate correlation matrix ($N = 61$)

	Mean	Standard Deviation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) Deforestation, 1990–2005	.646	1.026	1.000																	
(2) Women's NGOs, 1990 (Residualized)	−.001	.319	−.164	1.000																
(3) Environmental NGOs, 1990	.897	1.165	−.221	.005	1.000															
(4) Structural adjustment, 1990	2.368	.442	.261	−.046	.128	1.000														
(5) Total debt service, 1990	2.841	.814	.342	.173	−.014	.324	1.000													
(6) IMF-WB debt service, 1990	2.743	.828	.375	−.191	−.009	.342	.987	1.000												
(7) GDP, 1990	7.638	.817	−.342	.178	.106	−.001	−.194	−.236	1.000											
(8) Economic growth, 1980–1990	2.128	4.492	.149	−.017	.245	.090	.242	.270	−.184	1.000										
(9) Service economic activity, 1990	45.054	11.118	−.058	.183	.260	.215	−.024	−.026	.340	.169	1.000									
(10) Manufacturing economic activity, 1990	16.345	8.102	−.281	.079	−.049	.069	−.180	−.207	.396	−.111	−.081	1.00								
(11) Government expenditures, 1990	2.6311	.421	−.086	.076	.178	−.221	−.293	−.334	−.059	−.172	−.155	.001	1.000							
(12) Democracy, 1990	4.172	1.643	.094	−.128	−.334	−.323	−.257	−.220	−.624	−.071	−.490	−.083	.129	1.000						
(13) Population growth, 1980–1990	2.114	.950	.291	−.100	.218	−.099	.147	.148	−.437	.349	.054	−.275	.123	.270	1.000					

Table 1 continued

	Mean	Standard Deviation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(14) Rural population growth, 1980–1990	1.111	1.428	.297	−.164	.186	−.101	−.040	−.014	−.579	.384	−.089	−.201	.085	.378	.728	1.000				
(15) Urban population growth, 1980–1990	3.590	1.711	.257	−.102	.151	−.124	.184	.209	−.655	.431	−.022	−.427	.048	.357	.738	.677	1.000			
(16) Forest stocks, 1990	8.694	2.033	.035	−.166	−.440	.167	.264	.206	−.008	−.104	−.043	.096	−.013	.011	.080	−.055	−.013	1.000		
(17) Data quality	.623	.488	−.180	−.085	.274	.165	.229	.223	.167	.190	.200	−.031	−.097	−.281	−.084	−.095	−.098	−.138	1.000	
(18) Tropical climate	.803	.400	.342	.074	.128	.114	.181	.190	−.022	.396	.221	−.132	−.113	.103	.497	.371	.386	.124	−.041	1.000

Independent variables

Women's non-governmental organizations

Our central independent variable is the number of women's NGOs that *explicitly* focus on issues related to the environment and development. We collected the data in the following manner. Trynza (1990) categorizes NGOs by subject for scholars interested in knowing what NGOs are present in a nation. We used this to identify *international* NGOs that focus on women, environmental, and development issues in 1990 (e.g., Women's Environment and Development Organization). We then used *The Yearbook of International Associations,* offering country-specific data, to identify the number of women's NGOs operating within each nation. According to the *Yearbook of International Associations*, an international NGO is an NGO that has operations or members in two or more nations—see below for a discussion of the limitations of using this operationalization. We divide the count for each nation by the country's 1990 population size in millions (World Bank 2003) to standardize the measure. The average number of women's NGOs per one million people in our sample is .416. Trinidad has the highest number of women's NGOs per capita in our sample with 2.46. Gabon has the least women's NGOs per capita in the sample with 0.

One potential limitation of the data is that they include *only* international NGOs. Domestic NGOs are excluded from the totals for each nation. This clearly underestimates the number of women's NGOs working on environmental issues within a nation. As Bradshaw and Schafer (2000) note, however, data on domestic NGOs are not widely available because domestic NGOs are often very small and, therefore, not registered with the government or other bodies. Further, some domestic NGOs may try to "disguise" their efforts from the government to avoid interference or harassment.

Another potential data limitation pertains to the variable measuring the number of women's NGOs per capita within a nation. This tells us nothing about the types of projects being undertaken or the amount of being money spent on conservation projects and programs. While this type of detailed data would provide a more accurate test the relationship between women's NGOs and forest loss, such data are not available at this time. Nevertheless, if they become available, then future research would benefit for its use (Smith and Wiest 2005).

The women's and environmental NGOs are highly correlated. Such a problem usually prevents researchers from including highly correlated variables in analyses together (London and Ross 1995). However, we "residualize" the women's non-governmental organization variable by regressing it on the number of environmental NGOs per capita (Jorgenson 2003). We then use the residuals from this regression as the women's non-governmental organization independent variable in the models. This procedure minimizes problems with multicollinearity and allows us to examine both factors simultaneously. From above, world polity theory suggests that women's NGOs density should decrease deforestation.

Environmental non-governmental organizations

We also include the total number of NGOs, by nation, in 1990. These data were collected by Smith (2004) from the *Yearbook of International Associations*. The international NGOs included are those organizations that focus explicitly on environmental or animal rights issues (Smith and Wiest 2005). The variable excludes data on labor unions, foundations, and institutes. See Smith and Wiest (2005) or Smith (2004) for a full discussion involving the coding of this variable. This measure is also standardized to reflect organizations per capita. Please note that this measure only include international NGOs as well and, therefore, has the same limitations as the women's NGO measure. From above, world polity theory hypothesizes that nations with high levels of environmental NGOs per capita should be associated with lower rates of deforestation.

Structural adjustment

To capture the effects of structural adjustment or loans from the World Bank and International Monetary Fund, we use Walton and Ragin's (1990) conditionality index I. This index is the sum of four variables which include (1) the number of debt renegotiations between a country and an international financial body, (2) the number of debt restructurings experienced by an indebted nation, (3) the number of times a country utilized the International Monetary Fund Extended Fund Facility, and (4) the total International Monetary Fund loans received by a country as a percentage of its allocated quota. The variables are measured in 1990. The four components of the index are converted to z-scores and summed. It has been used previously by Shandra, London, and Williamson (2003), Bradshaw and Schafer (2000), Schafer (1999), and Buchman (1996). We log this variable to correct for its skewed distribution.

Shandra et al. (2008a, b, c) find that nations with high levels of structural adjustment tend to be associated with more deforestation. They attribute this finding to structural adjustment loans requiring nations to boost exports of primary products while cutting government spending on conservation and environmental protection (Peet 2003; Tockman 2001; Rich 1994; George 1992).

Total debt service ratio

In addition to the pressure to adjust their economies under structural adjustment, indebted nations must continually service their foreign debts. Therefore, it is also important to control for debt service as well as structural adjustment. This approach has been used previously by Bradshaw and Schafer (2000), Schafer (1999), and Buchman (1996). Thus, we also include the average sum of principal and interest payments in foreign currency, goods, or services on long-term public and publicly guaranteed private debt with maturity of one year or longer as a percentage of goods and services exports from 1988 to 1992. The data come from the World Bank (2003). We log this variable to deal with its skewed distribution.

Like structural adjustment, debt service should increase deforestation (Barbosa 2001). Under constant pressure to service large foreign debts, governments attempt

to increase export earnings in order to finance interest and principal payments. This, in turn, may increase deforestation because the sectors targeted for export include forestry, agriculture, cattle ranching, and mining (Barbosa 2001). Marquart-Pyatt (2004), Rudel and Roper (1997), and Kahn and MacDonald (1994) find that higher levels of debt service are correlated with higher rates of deforestation.

International monetary fund and world bank debt service ratio

We also include the average debt service ratio that covers long-term public debt and repayments *only* to the International Monetary Fund and World Bank. The data are measured as a percentage of exports of goods and services from 1988 to 1992. They may be obtained from the World Bank (2003). This variable is logged to control for its skewed distribution. Like total debt service, we expect that this variable should be associated with more forest loss.

Gross domestic product

As is standard in such analyses, it is incumbent on us to take into account a nation's level of development in order to make sure that any effects discovered are independent of a nation's level of wealth (London and Ross 1995). In this regard, we employ a measure of gross domestic product per capita at parity purchasing power for 1990. We log this variable to correct for its skewed distribution. Shandra (2007a), Jorgenson (2006), and Rudel (1989) find that economic development reduces deforestation. Burns et al. (2003) attribute this finding to wealthier nations "externalizing" their environmental costs by importing natural resources from poorer nations. Thus, we anticipate an inverse relationship gross domestic product per capita and deforestation.

Economic growth

We also include the average annual economic growth rate from 1980 to 1990. The data come from the World Bank (2003). It is generally thought that economic growth should increase deforestation. This is because there are large amounts of capital available for investment in activities that accelerate forest loss during periods of economic growth (Rudel 1989).

Service-based economic activity

We also include value added from services as a percentage of gross domestic product for 1990. These data also come from the World Bank (2003). Ehrhardt-Martinez et al. (2002) and Ehrhardt-Martinez (1998) argues that a shift from agriculture to service-based economic activity should decrease deforestation. This occurs because the creation of jobs in sectors other than agriculture has the potential to attract people to cities and relieve the human demand for forest resources (Ehrhardt-Martinez et al. 2002). Thus, we would hypothesize that nations with large service sectors should be associated with less deforestation.

Manufacturing-based economic activity

We also take into account value added from the manufacturing sector as a percentage of gross domestic product for 1990. The data are available from the World Bank (2003). We include this variable as an additional control for the structure of a domestic economy. As discussed above, nations that are based upon economic activities outside of agriculture should have less forest loss. Thus, we would hypothesize higher levels of manufacturing activity should be inversely correlated with deforestation.

Government expenditures

We also include a variable to assess the effect of a government's fiscal capacity or state strength on deforestation (Crenshaw and Jenkins 1996). It is the total amount of central government expenditures as a percentage of gross domestic product for 1990. The data may be obtained from the World Bank (2003). Deacon (1994) argues that when governments lack the ability to enforce controls on how forests are used (i.e., low levels of state strength) they tend to be treated as free access resources and, thus, deforestation ensues. Ehrhardt-Martinez et al. (2002) find the expected inverse relationship between government expenditures and deforestation.

Democracy

We use the average of Freedom House's (1997) political rights and civil liberties scales to measure democracy. Political rights reflect the degree to which a nation is governed by democratically elected representatives and has fair, open, and inclusive elections. Civil liberties reflect whether within a nation there is freedom of press, freedom of assembly, general personal freedom, freedom of private organizations, and freedom of private property (Freedom House 1997). Both variables have a seven-point scale with the following codes: free (1–2), partially free (3–5), and not free (6–7). We multiply our index by negative one so that high scores correspond with high democracy. Li and Reuveny (2006) find that higher levels of democracy are correlated with lower rates of deforestation. They attribute this finding to democratic nations have higher levels of activism than repressive nations and democratic nations being more responsive to political activism because of electoral accountability (Marquart-Pyatt 2004; Ehrhardt-Martinez et al. 2002).

Population growth

The neo-Malthusian perspective suggests that demographic factors shape deforestation. Therefore, we include average annual total population growth from 1980 to 1990 in the analysis. The population growth rate data come from the World Bank (2003). Many cross-national studies find that population growth increases deforestation (e.g., Shandra 2007a, Jorgenson 2006, Ehrhardt-Martinez 1998, and Rudel 1989). The general argument suggests that "geometric" growth in population outstrips "arithmetic" growth in the means of subsistence, leading to the pessimistic

conclusion that "carrying capacity" and ensuing environmental problems (Ehrlich and Ehrlich 2004). Rudel and Roper (1997) provide a detailed discussion of the ways in which population growth may increase deforestation in poor nations.

Rural and urban population growth

York et al. (2003) argue that it is important to "decompose" demographic factors in cross-national research. That is, researchers should examine not just overall growth rates per se but also the impact of growth in different contexts. Recently, Jorgenson and Burns (2007) find that rural population growth increases deforestation while urban population growth decreases it. They argue that expanding urban centers often create economic opportunities other than agricultural ones, which attract people to cities. This process relieves pressure on forest and, thus, reduces deforestation. Therefore, we also decompose population in this analysis and examine the differential effects of rural and urban population growth. Accordingly, we include the average annual percentage change of rural and urban populations from 1980 to 1990. The data may be obtained from the World Bank (2003). We would expect that higher rural population growth rates should be associated with higher deforestation rates, while higher urban population growth rates should be associated with lower deforestation rates.

Natural forest stocks

It is necessary to include a measure that controls for the potentially biasing effects of relative abundance or scarcity of forest resources (Rudel 1989). Therefore, we include natural forest area for 1990. We log this variable to control for its skewed distribution. The data may be obtained from the Food and Agriculture Organization (2005).

Data quality

We also take into account the data quality of the deforestation estimates. The data may be obtained from the Food and Agriculture Organization (2005). We classify forestry statistics as being highly reliable if they are based upon remote sensing survey or current national field sampling estimates (Shandra 2007c). We classify forestry statistics as having low reliability if they are based upon expert estimates, which often involves extrapolation from an outdated national inventory. As such, we include a dummy variable for reliability of deforestation, identifying those nations in which forest cover measures are based upon remote sensing surveys or current national field sampling estimates and should, therefore, be of higher quality (1 = high data quality). The reference category includes nations whose forestry estimates are based upon expert estimates or an outdated inventory (0 = low data quality).

Tropical climate

We also include a dummy variable to control for the predominant climate of a nation (York et al. 2003). We code tropical nations with a value of one

(1 = tropical). The reference category, which includes all other nations, is coded with a value of zero. The World Resources Institute (2005) classifies a nation as being tropical if more than half its land area has a mean monthly temperature that exceeds 18°C. We hypothesize that tropical nations should be associated with more deforestation because they tend to have more valuable tree species that are in demand on the world market (Rudel 1989).

Findings

In Table 2, we present the ordinary least squares estimates of deforestation. The central independent variables included in every equation are the residualized women's non-governmental organization variable and the environmental non-governmental organization variable. We also include the following theoretically relevant control variables: structural adjustment, debt service, gross domestic product per capita, economic growth, service-based economic activity, manufacturing-based economic activity, government expenditures, measures of population growth, democracy, forest stocks, data quality, and a tropical climate dummy variable. In equations (2.1) through (2.4), we include total debt service, and in equations (2.5) through (2.8) we include debt service to only the International Monetary Fund and World Bank. We "decompose" population growth into rural and urban population growth in equations (2.3), (2.4), (2.7), and (2.8). We use multiple indicators of similar theoretical constructs to demonstrate the reliability of the findings and help guard against measurement error (Paxton 2002). We remove non-significant predictors in even-numbered equations in order to ensure that we are not including too many predictors for a sample of 61 nations (Shandra 2007a). Finally, because significant Breusch-Pagan tests indicate potential problems with heteroskedasticity, we present White's corrected standard errors (Ehrhardt-Martinez et al. 2002).

We begin by focusing on significant findings. First, we find substantial support for world polity theory in that the results suggest that women's and environmental NGOs are associated with less deforestation. The estimated coefficients for these variables are negative and significant in every equation of Table 2. Second, we also find support for that debt and structural adjustment are correlated with increased deforestation. The coefficients for these variables are positive and significant in every equation. Third, we find some support for neo-Malthusian theory in that the estimated coefficients for total population growth are positive and significant in equations (2.1), (2.2), (2.5), and (2.6). We also find that it is important to decompose population growth since rural, but not urban, growth significantly predicts deforestation. The estimated coefficients for rural population growth are positive and significant in equations (2.3), (2.4), (2.7), and (2.8). Fourth, the coefficients for forest stocks are negative and significant in every equation. Fifth, the coefficients for the tropical climate dummy variable are positive and significant in every equation. Thus, tropical nations tend to be associated with higher levels of deforestation than others. Sixth, the estimated coefficients for the data quality dummy variable are negative and significant in every equation.

Table 2 Estimates with White's heteroskedastistic corrected standard errors of deforestation (1990–2005) including women's and environmental non-governmental organizations

	Equation 2.1	Equation 2.2	Equation 2.3	Equation 2.4	Equation 2.5	Equation 2.6	Equation 2.7	Equation 2.8
World polity variables								
Women's non-governmental organizations, 1990 (residualized)	−.534**	−.485*	−.421**	−.388*	−.515**	−.430*	−.395*	−.364*
	−.166	−.142	−.131	−.121	−.161	−.134	−.123	−.113
	(.209)	(.246)	(.207)	(.216)	(.212)	(.251)	(.213)	(.219)
Environmental non-governmental organizations, 1990	−.497***	−.414***	−.495***	−.432***	−.492***	−.404***	−.492***	−.423***
	−.564	−.470	−.562	−.490	−.561	−.459	−.558	−.480
	(.093)	(.089)	(.096)	(.078)	(.094)	(.091)	(.097)	(.078)
Other theoretically relevant variables								
Structural adjustment, 1990	.842**	.748**	.842**	.802**	.818**	.724**	.808**	.777**
	.362	.322	.363	.346	.352	.312	.348	.334
	(.365)	(2.666)	(.363)	(.295)	(.366)	(.287)	(.365)	(.299)
Total Debt Service Ratio, 1990	.306*	.345**	.468**	.416***				
	.243	.274	.371	.330				
	(.164)	(.116)	(.174)	(.115)				
International monetary fund and world bank debt service ratio, 1990					.321**	.341***	.477***	.413***
					.259	.272	.385	.333
					(.154)	(.110)	(.159)	(.111)
Gross domestic product, 1990	.050		.250		.061		.262	
	.040		.199		.048		.385	
	(.264)		(.282)		(.264)		(.159)	
Economic growth rate, 1980–1990	−.002		−.012		−.003		−.014	
	−.009		−.052		−.087		−.062	
	(.025)		(.027)		(.024)		(.027)	

Table 2 continued

	Equation 2.1	Equation 2.2	Equation 2.3	Equation 2.4	Equation 2.5	Equation 2.6	Equation 2.7	Equation 2.8
Service-based economic activity, 1990	−.009		−.004		−.008		−.005	
	−.087		−.048		−.087		−.051	
	(.010)		(.011)		(.010)		(.011)	
Manufacturing-based economic activity, 1990	−.020		−.026*	−.018*	−.019		−.025*	−.017
	−.162		−.208	−.145	−.157		−.202	−.139
	(.016)		(.015)	(.011)	(.016)		(.013)	(.012)
Government Expenditures, 1990	.401		.478**	.422*	.430		.516**	.449**
	.164		.196	.173	.176		.212	.184
	(.257)		(.230)	(.217)	(.258)		(.233)	(.219)
Democracy, 1990	−.088		−.043		−.091		−.051	
	−.141		−.069		−.145		−.081	
	(.152)		(.143)		(.148)		(.138)	
Population growth rate, 1980–1990	.276*	.280**			.279*	.278**		
	.256	.259			.258	.257		
	(.155)	(.135)			(.153)	(.135)		
Rural population growth rate, 1980–1990			.277**	.162**			.280***	.156**
			.386	.225			.389	.218
			(.096)	(.061)			(.091)	(.061)
Urban population growth rate, 1980−1990			−.017				−.017	
			−.028				−.028	
			(.100)				(.098)	
Natural forest stocks, 1990	−.221**	−.203**	−.215**	−.192**	−.214**	−.191**	−.203***	−.179**
	−.439	−.403	−.426	−.381	−.425	−.378	−.402	−.355
	(.095)	(.087)	(.089)	(.084)	(.091)	(.086)	(.083)	(.081)

Table 2 continued

	Equation 2.1	Equation 2.2	Equation 2.3	Equation 2.4	Equation 2.5	Equation 2.6	Equation 2.7	Equation 2.8
Data quality, 1990	−.410*	−.418*	−.458*	−.417*	−.409*	−.412*	−.453*	−.409*
(1 = high reliability)	−.195	−.199	−.218	−.198	.195	−.196	−.216	−.194
	(.256)	(−1.669)	(.247)	(.238)	(.248)	(.239)	(.242)	(.235)
Tropical climate (1 = yes)	.822**	.656**	.831**	.736**	.818**	.641**	.830***	.729**
	.321	.256	.324	.287	.319	.251	.324	.284
	(.288)	(.720)	(.288)	(.262)	(.283)	(.285)	(.281)	(.259)
Adjusted R-Square	.543	.491	.576	.546	.547	.491	.581	.546
Number of cases	61	61	61	61	61	61	61	61
Highest variance inflation factor score	3.555	1.570	.4115	1.620	3.420	2.580	4.139	1.613
Mean variance inflation factor score	1.880	1.382	2.091	1.348	1.874	1.387	2.090	1.358
Breusch-Pagan heteroskedasticity test	9.041*	5.890*	10.240*	9.240*	8.585*	5.014*	9.621*	8.860*

Indonesia is removed from the analysis because it is an influential case

* $p < .05$; ** $p < .01$; *** $p < .001$ for a one-tailed test. The first number reported is the unstandardized coefficient, the second number is the standardized coefficient, and the third number in parentheses is the robust standard error. Significant Breusch-Pagan tests indicate the presence of heteroskedasticity in the model. Thus, we present White's corrected standard errors to deal with this issue

There are some non-significant and inconsistent findings that also should be mentioned. Let us begin by considering the economic variables. We do not find that economic growth, economic development, or service-based economic activity are correlated with deforestation. The coefficients for all of these variables fail to achieve a level of statistical significance.[2] We do find limited support for the idea that manufacturing-based economic activity significantly predicts deforestation. The coefficients are negative and significant in only half of the equations of Table 2. Now let us turn to the remaining political variables. We find no support that democracy is correlated with deforestation. The coefficients for this variable are not statistically significant in any equation.[3] We do find limited support that government spending is associated with deforestation. The coefficients for this variable are significance in equations (2.3), (2.4), (2.7), and (2.8).[4]

Discussion and conclusion

This study expands upon previous cross-national research in the world polity tradition in a novel way. In particular, we build cross-national models of deforestation to consider *not only* the impact of environmental *but also* women's NGOs. Clearly, it is important to consider women in cross-national research because many women in developing nations tend to be adversely affected by forest loss through increased household labor, loss of income generating activities, and impaired health. Further, women's NGOs have become increasingly active in dealing with these issues by protecting forests—as evidenced by Maatthai (2006a),

[2] Ehrhardt-Martinez et al. (2002) find that an environmental Kuznets curve exists between gross domestic product per capita and deforestation. We test this hypothesis using a quadratic polynomial equation in which the gross domestic product per capita and its square are entered into the same model. If this relationship exists, the sign of the coefficient for the level of development should be positive and the sign of the coefficient for the squared term should be negative with this term being statistically significant. To reduce problems of multicollinearity, we begin by centering the linear term around its mean. We then square the centered term. Finally, we include the centered linear term and squared term in our models (York et al. 2003). The coefficients for the squared term are negative but fail to achieve statistical significance. We also tested for the possibility of an environmental Kuznets curve between a nation's level of urbanization and deforestation (Ehrhardt-Martinez 1998). We use the same procedure described above to test this hypothesis but find no support for it.

[3] Bollen and Paxton (2000) argue that non-random measurement error arising from the subjective perceptions of judges affect all cross-national measures of democracy to some degree. This bias may distort comparisons across nations, undermining the empirical results that ignore it. Therefore, we also estimate our models using the level of democracy or autocracy in a nation using data from the Polity IV Project (2005). This measure ranges from—10 (autocracy) to 10 (democracy). The results using this measure are very similar to the results reported for the measurements of democracy in Table 1. We do not present these results for sake of space.

[4] We also included a series of dummy variables to account for findings that may arise out of geographical circumstances, which cannot be accounted for by the independent variables in the model (Shandra 2007c). These dummy variables identify a nation as being located in Latin America and the Caribbean, Asia, or Africa. The reference category includes nations in Europe. The coefficients for the geographical control variables failed to predict any significant variation in deforestation. The other findings remained similar to the results reported in Table 2. We do not present the results for sake of space, but they are available from the authors upon request.

Rudel (2005), and Guha (2000) among others. As such, we find substantial evidence that *both* types of NGOs are correlated with lower rates of deforestation. We increase the reliability of our findings by demonstrating their significance across alternative model specifications including techniques for handling missing data.[5]

These findings lead us to agree with Norgaard and York (2005). In general, gender deserves greater attention in cross-national research, while the role women's NGOs play in protecting the environment deserves more attention specifically. Moreover, this study points to the importance of considering the impact of different types of NGOs in cross-national research because it allows for a more detailed examination of world polity theory's hypotheses regarding how NGOs affect the natural environment (Shandra et al. 2008a).

We also confirm hypotheses from previous research. First, both debt service and structural adjustment are associated with increased deforestation. Second, we demonstrate the need to include demographic factors in cross-national models of deforestation (e.g., Jorgenson and Burns 2007; Rudel 1989). Both the total and rural population growth rates are correlated with increased deforestation. Third, we document the importance of including several control variables in the analyses. These controls include forest stocks, data quality, and tropical climate. In fact, the significance of the women's non-governmental organization variable in models that include these controls provides a conservative test of this hypothesis and greatly enhances our confidence in this finding.

There are some policy implications that correspond with our main findings regarding NGOs, debt, and deforestation. Many environmental NGOs (e.g., Conservation International, World Wildlife Fund, and Nature Conservancy) have focused their efforts on projects that simultaneously decrease debt and deforestation (Bryant and Bailey 1997). One of the most commonly used approaches has been the debt-for-nature swap (Cartwright 1989). A debt-for-nature swap usually involves environmental NGOs paying off a portion of a nation's debt in return for the recipient nation setting aside a certain amount of land for complete protection (Cartwright 1989). However, environmental NGOs that conduct debt-for-nature swaps have been criticized for promoting an "environment-first" rather than "people-first" policy (Newell 2000; Bryant and Bailey 1997). Put differently, conservation tends to be conducted without due regard for the livelihood needs of local populations living in the area designated for protection (Rudel 2005).

[5] A problem that commonly arises in cross-national research is that of missing data. Statistical procedures such as multivariate regression analysis generally assume that each country has complete data. However, for numerous reasons, countries may be missing values on one or more of the variables under investigation. When this is the case, questions may emerge about the extent to which inferences about the parameters and tests of statistics are influenced by the presence of incomplete data. When using listwise deletion, for example, the effective sample size only includes those nations with complete records, and, consequently, this number can be substantially smaller than the original sample size if missing observations are scattered across many nations. Further, nations that are excluded will often be the poorer countries that have fewer resources to allocate toward record keeping. Thus, the final sample may not be representative of the poorest nations. We attempt to determine if our estimates are biased by listwise deletion by using Arbuckle's (1996) full information maximum likelihood estimation routine to handle incomplete data. This approach has been used by Jorgenson (2003), Paxton (2002), and Kentor (2001). The size and significance of the full information maximum likelihood estimates are remarkably similar to the listwise deletion estimates, providing little evidence that the listwise deletion results are biased.

Consequently, local people, who depend upon the forest for survival, are denied access as part of the debt-for-nature swap (Bryant and Bailey 1997). The effects of this problem are felt by many women in developing nations (Chapin 2004). Thus, environmental NGOs should work with women's NGOs to ensure that conservation projects do not deny women access to forests. In the case of a debt-for-nature swap, this should include demarcating extractive reserves and "buffer" zones designated for other land uses (i.e., agroforestry projects). There should also be a focus on income generating activities around protected areas that are proposed and managed by women at the local level (Rocheleau et al. 1996).

We conclude with some directions for future research. First, gender clearly deserves greater attention in cross-national work on the natural environment. Our findings highlight that women's NGOs are associated with decreases in forest loss. However, women are also responsible with supplying water for the household (Buckingham-Hatfield 2000). Thus, future research should consider if women's NGOs help to protect water resources, thereby increasing access to safe drinking water. Second, we employ a macro-comparative methodology to examine the relationship between women's NGOs and deforestation. However, cross-national research can not describe in detail how women's NGOs try to reduce deforestation in specific locations (Smith 1996). Therefore, case study analyses of this relationship at the sub-national and organizational levels are essential (Rudel 2005). Such an approach would also allow researchers to determine if there are regional variations in the pattern of results presented here.

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