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MASTER OF MILITARY STUDIES

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**TITLE:**

HOW ANALYZING ENVIRONMENTAL SECURITY  
SUPPORTS UNDERSTANDING THE OPERATIONAL APPROACH

SUBMITTED IN PARTIAL FULFILLMENT  
OF THE REQUIREMENTS FOR THE DEGREE OF  
MASTER OF MILITARY STUDIES

**AUTHOR:**

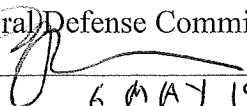
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## Executive Summary

**Title:** How Analyzing Environmental Security Supports Understanding the Operational Approach

**Author:** Major Christopher Driscoll, United States Marine Corps

**Thesis:** The effects of climate-induced environmental stress contribute to security challenges; the current Joint Intelligence Preparation of the Operational Environment process does not account for these relationships. The increasingly complex nature of the modern operational environment requires viewing the traditional analytical framework from an alternative perspective to improve the effectiveness of the operational approach.

**Discussion:** Approaching the problem of environmental security from outside the context of military thought leverages parallel efforts to address the issues of complex systems interaction in the field of social science. This project tests the validity of the thesis statement by replicating the research methodology of one of the leading scholars in the field of political science.

**Conclusion:** The results of the research varied in statistical significance, but the project demonstrated the potential for the application of social science systems theory in a military context to develop an understanding of the operational environment informed by statistical analysis. The Department of Defense should expand the scope of this line of inquiry to evaluate the relevance of this argument on a larger scale.

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## *Introduction*

This study examines the correlation between climate change and conflict using a method of analysis initially published by one of the preeminent scholars in the field of Political Science, Thomas Homer-Dixon. The complexity of the subject material and variance in the findings demonstrates the utility of testing contemporary conflict theories against factual evidence to develop an understanding of the operational environment informed by statistical analysis. Military planners need a better way of thinking about how the environment shapes the character of war amidst growing concerns about climate change and environmental vulnerability.

The task of understanding the operational environment presents the first of many challenges a planning staff faces throughout the Joint Planning Process. The United States Department of Defense publication for Joint Intelligence Preparation of the Operational Environment (JIPOE) defines the operational environment as “a composite of the conditions, circumstances, and influences that affect the employment of capabilities and bear on the decisions of the commander.”<sup>1</sup> This process synchronizes a staff’s effort to build a common understanding of the factors that shape and influence the character of an impending operation. The second step of this process centers around developing a contextual understanding of the problem from a geospatial and systems perspective to describe how the operational environment affects a force’s capabilities, limitations, and potential courses of action.<sup>2</sup>

Analyzing the operational environment from a systems-based perspective centers around understanding the “significant relationships and interdependencies within and between interrelated political, military, economic, social, information, infrastructure (PMESII) and other

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<sup>1</sup> Joint Publication 2-01.3, *Joint Intelligence Preparation of the Operational Environment* (Washington, DC, 2014), ix, [https://jdeis.js.mil/jdeis/new\\_pubs/jp2\\_01\\_3.pdf](https://jdeis.js.mil/jdeis/new_pubs/jp2_01_3.pdf).

<sup>2</sup> Joint Publication 2-01.3, III-1.

systems relevant to a specific joint operation.”<sup>3</sup> This method of analysis outlines a framework for determining *what* a staff should consider but does not prescribe a process to determine *how* these variables interact. Instead, evaluating the significance of the relationships identified by the JIPOE process falls on the judgment of the planning staff, who rely primarily on their functional expertise and the application of operational art to reach their conclusions.<sup>4</sup>

The increasingly complex nature of the modern operational environment highlights the potential value in viewing the PMESII framework from an alternative perspective. Approaching the problem from outside the context of military thought leverages parallel efforts to address the issues of complex systems interaction in the field of social science. Current studies to assess these relationships build on almost forty years of critical thought and comprehensive peer review in various academic circles.<sup>5</sup> The results of those efforts cover a broad spectrum of topics from demographics and economics to political systems and climate change; many of the studies correlate their research with areas of interest for military planners, specifically conflict.<sup>6</sup>

### ***Background***

The topic of climate change and how it pertains to conflict elicits a broad spectrum of responses from researchers in the field; the issue is subject to controversy primarily due to the overwhelming scale of the problem, the complexity of the causal relationships in question, and the lack of a standardized research methodology to examine the issues in proper context.

Political Scientist Thomas Homer-Dixon addresses these issues in his seminal work on the

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<sup>3</sup> Joint Publication 2-01.3, I-4.

<sup>4</sup> Joint Publication 3-0, *Joint Operations* (Washington, DC, 2017), I-13, [https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3\\_0ch1.pdf?ver=2018-11-27-160457-910](https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_0ch1.pdf?ver=2018-11-27-160457-910).

<sup>5</sup> Michael C. Jackson, “Social Systems Theory and Practice: The Need for a Critical Approach,” *International Journal of General Systems* 10, no. 2-3 (January 1, 1985): 135, <https://doi.org/10.1080/03081078508934877>.

<sup>6</sup> Martin C. Libicki, Howard J. Shatz, and Julie E. Taylor, “The Influence of Demographics on the Causes of War,” in *Global Demographic Change and Its Implications for Military Power* (RAND Corporation, 2011), 88, <http://www.jstor.org/stable/10.7249/mg1091af.13>; Wenche Hauge and Tanja Ellingsen, “Beyond Environmental Scarcity: Causal Pathways to Conflict,” *Journal of Peace Research* 35, no. 3 (1998): 299.

subject published under the title *On the Threshold: Environmental Changes as Causes of Acute Conflict*. Not surprisingly, his work generated a significant amount of debate at the time of its publication almost three decades ago; more importantly, it continues to garner attention from other researchers in the field due to the systematic approach Homer-Dixon applies to the study of climate change and how it relates to security concerns. This section provides an assessment of the framework outlined in the original research and summarizes the counter-arguments made by other researchers in the field.

### **Theoretical Overview**

Homer-Dixon's proposal begins with an assessment of the shortcomings of existing design methodologies; he addresses the limitations of a generalized approach to the problem by underlining the need for a method of analysis that provides a higher level of specificity to the process.<sup>7</sup> His criticism of contemporary research acknowledges the complexity of social-environmental systems and "the myriad of variables and their interactive, synergistic, and nonlinear causal relations."<sup>8</sup> His evaluation highlights the need for an inter-disciplinary approach to the problem in order to adequately address the wide span of intervening variables that contribute to the cause and effect relationships in question.<sup>9</sup> In short, Homer-Dixon argues that previous attempts to study the issue of climate change and conflict are too generalized and lack an adequate depth of analysis, or the aperture is not wide enough to address the multi-dimensional nature of the problem. He addresses these issues by proposing an analytical model that separates the problem set into digestible segments without sacrificing analytical depth.

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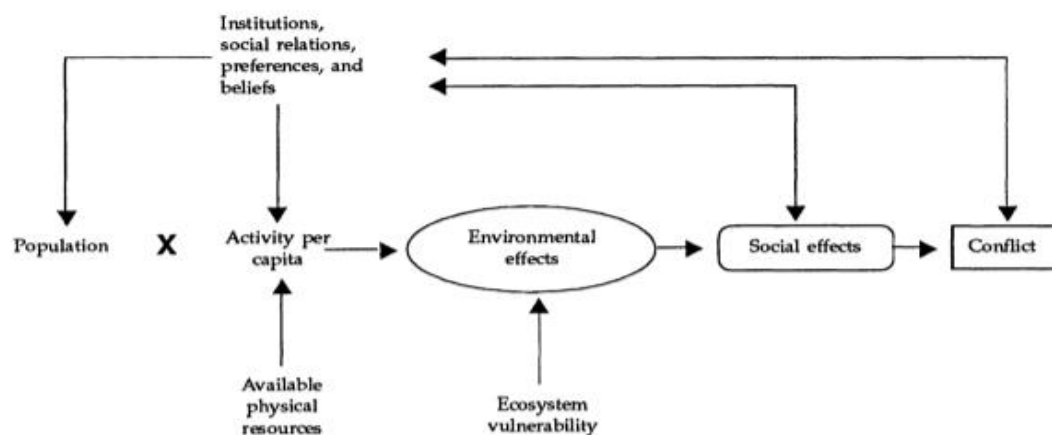
<sup>7</sup> Thomas F. Homer-Dixon, "On the Threshold: Environmental Changes as Causes of Acute Conflict," *International Security* 16, no. 2 (1991): 84, <https://doi.org/10.2307/2539061>.

<sup>8</sup> Homer-Dixon, 84.

<sup>9</sup> Homer-Dixon, 84.

His choice to assess the effects of climate change and how they pertain to conflict reduces the complexity of the challenge posed by an analysis of how climate change affects security as a whole; the base argument suggests the ill-defined nature of security prevents researchers from analyzing the causal relationships from a holistic perspective.<sup>10</sup> Relegating the dependent variable to conflict eliminates the need to synthesize the metrics for multiple intervening variables; similarly, leveraging existing research that capture conflict data simplifies the problem of collection and facilitates a scalable analysis of the problem. Homer-Dixon's analytical framework sustains this line of reasoning by separating actors, influences, and effects into distinct and measurable entities, thus enabling a systematic approach to the problem.

Homer-Dixon's method of analysis suggests environmental effects are a product of the total human population in a region and its capacity to generate environmentally-degrading effects; the consequences of environmental change produce social effects that alter, change, or otherwise influence normative institutions and behaviors, the perpetuation of this cycle causes further degradation that inevitably leads to conflict (see Figure 1).<sup>11</sup> Homer-Dixon addresses the



Source: Homer-Dixon, Thomas F. "On the Threshold: Environmental Changes as Causes of Acute Conflict." *International Security* 16, no. 2 (1991): 76–116. <https://doi.org/10.2307/2539061>.

<sup>10</sup> Homer-Dixon, 77.

<sup>11</sup> Homer-Dixon, 86.

complexity of these interactions by separating the analytical approach into multiple lines of effort.

First, he examines the relationship between a population and the environment; his findings outline seven major environmental effects that result from human-induced activity: greenhouse warming, stratospheric ozone depletion, acid deposition, deforestation, degradation of agricultural land, overuse and pollution of water supplies, and depletion of fish stocks.<sup>12</sup> Next, the model applies four primary metrics to determine how environmental effects influence social practices by assessing: agricultural production, economic decline, population displacement, and disrupted institutions.<sup>13</sup> Finally, Homer-Dixon addresses how these social effects shape the nature of conflict by applying theoretical perspectives of conflict at the individual, group, and structural level; this results in the proposal that environmental degradation produces three types of conflict: simple scarcity, group identity, and relative deprivation.<sup>14</sup> In theory, this method of reasoning accounts for the second and third order social effects stemming from a single aspect of climate change by accounting for how these processes inform one another to create the potential for conflict across multiple levels of society.

One key aspect of Homer-Dixon's analysis is his recognition of the potential for what he labels "second stage interventions"; this idea captures the possibility that any of the causal linkages outlined above are subject to interruption by variables outside the system in question.<sup>15</sup> This proposal brings the issue of policy into the equation, both of the country subject to the effects of environmental change as well as any external actors that have an interest in the resulting social effects. This line of thought addresses the political nature of the problem and

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<sup>12</sup> Homer-Dixon, 88.

<sup>13</sup> Homer-Dixon, 91.

<sup>14</sup> Homer-Dixon, 106.

<sup>15</sup> Homer-Dixon, 114.

highlights the importance of regime type, public perception of government, and how third parties influence these relationships.<sup>16</sup> This distinction underlines the potential for Homer-Dixon's model to provide an understanding of the problems faced in environmentally vulnerable states before developing a whole of government approach to prevent conflict or restore order as an intervening actor.

### **Competing Perspectives**

The theoretical framework outlined above is subject to a variety of critiques from past and present scholars alike. A review of the existing literature reveals several common themes from the opponents of and proponents for Homer-Dixon's original work. The most notable dialogue centers around the complexity of the issue in question, the context of the research, and the policy implications for practical application.

Of the topics highlighted above, the question of complexity generates a significant portion of academic debate. Scholars such as Mark Levy point out that environmental scarcity is but a single variable in the complex interactions between the factors that contribute to political violence; he submits that framing the problem from an environmental standpoint obscures the understanding of how the other drivers of conflict impact the context of the situation.<sup>17</sup> Political Scientist Idean Salehyan posits a similar argument; a systems-based causal analysis has the potential to ignore or otherwise neglect the myriad of intervening variables that influence an individual's or state's decision-making process when faced with problems attributable to resource scarcity.<sup>18</sup> These assertions are not without merit; they do, however, highlight the value

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<sup>16</sup> Homer-Dixon, 114.

<sup>17</sup> Thomas F. Homer-Dixon and Marc A. Levy, "Environment and Security," *International Security* 20, no. 3 (1995): 198, <https://doi.org/10.2307/2539143>.

<sup>18</sup> Idean Salehyan, "From Climate Change to Conflict? No Consensus Yet," *Journal of Peace Research* 45, no. 3 (2008): 317.

of a systems-based approach to understanding the operational environment. Homer-Dixon's model may not address the issue holistically, but it does create a framework that correlates action with measurable effects. Recognizing the potential shortfalls of this framework creates an opportunity to achieve a relative level of understanding in one area for comparison with the results of parallel efforts or complementary efforts.

Levy makes a similar distinction regarding the context of analysis in another study; his efforts to correlate environmental degradation with national security interests highlight the obstacles present in this type of research, specifically how the choice to focus analytical energy influences the utility of the findings.<sup>19</sup> Levy argues that Homer-Dixon's selection of case studies presents a one-sided representation of the effects of environmental degradation because they only focus on regions where violence occurs while neglecting to consider areas that do not experience violence despite the presence of degradation.<sup>20</sup> This assertion suggests that there are inherent limitations to the application of studies that don't account for variance in the dependent variable. Homer-Dixon addresses this concern by arguing for the efficacy of a process that constrains the scope of analysis in order to test the analytical framework for conceptual errors or otherwise weak causal linkages from the onset before expanding the scale of the efforts.<sup>21</sup> This concept demonstrates a need for further testing of Homer-Dixon's model to validate or disprove the underlying premises outlined in his original study.

Another concern that emerges from research in this field is the question of how to determine the relevancy of the information discovered, and to what degree it applies to current and future policy discussions. Levy warns against the downfalls of studies specifically associated

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<sup>19</sup> Marc A. Levy, "Is the Environment a National Security Issue?," *International Security* 20, no. 2 (1995): 57, <https://doi.org/10.2307/2539228>.

<sup>20</sup> Levy, 58.

<sup>21</sup> Homer-Dixon and Levy, "Environment and Security," 193.

with a specific political aim citing the tendency to trend toward rhetoric or popular support when interpreting the analytical results.<sup>22</sup> Similar studies point to the often stark differences between scholarly research on the subject and the sensationalized opinions in circulation across a variety of news outlets and public forums.<sup>23</sup> These factors challenge the utility of research in the field without an appreciation of the circumstances behind the origination of the efforts; competition between ideas shapes not only the results of these studies but also the perceptions of those who evaluate their outcomes.

Traditional approaches to security concerns tend to focus on the nature of conflict and the factors that shape the decision-making process of the actors involved. Efforts concentrated at the individual level tend to rely on frustration-aggression theory; what Homer-Dixon describes as “when people perceive a widening gap between the level of satisfaction they have achieved...and the level they believe they deserve.”<sup>24</sup> Group-identity theory focuses on violence as a result of the creation of a shared identity between different subsets of a population based on characteristics such as religion, ethnicity or nationality; this line of thought builds on the idea an individual’s bias for action is stronger when they associate their grievances with the greater good of a group.<sup>25</sup> Structural theories account for the role of rational calculation on the part of the actors involved; this concept accounts for the interplay between different political and social systems that influence the perception of an actor or group regarding their likelihood of success; therefore influencing their decision to resort to hostile actions.<sup>26</sup>

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<sup>22</sup> Levy, “Is the Environment a National Security Issue?,” 42.

<sup>23</sup> Salehyan, “From Climate Change to Conflict? No Consensus Yet,” 317.

<sup>24</sup> Homer-Dixon, “On the Threshold: Environmental Changes as Causes of Acute Conflict,” 104.

<sup>25</sup> Homer-Dixon, 105.

<sup>26</sup> Homer-Dixon, 105.

The problem with the application of these theories is that researchers tend to isolate the scope of analysis to the character of the conflict as determined by the actors involved and the type of violence that occurs with limited evaluation of the relationships that influence how they interact. This point of contention highlights the need for an objective approach to the problem. In other words, can the model outlined by Thomas Homer-Dixon enhance the understanding of a complex operational environment by providing a means to correlate actions with measurable effects across multiple interrelated systems objectively?

### *Research Design*

#### **Framing the Approach**

This project sought to validate the previous question by conducting a replication study of Homer-Dixon's model in the case of Nigeria; every attempt was made to account for the counter perspectives outlined in the previous section in the interest of maintaining congruency with the competing literature on the subject. The purpose of these efforts is to offer an alternate lens through which military planners can view the factors that shape their operational environment. The selection of Nigeria as the country in question was determined primarily due to its environmental vulnerability, the complexity of its conflict, and the amount of data available for analysis. Additionally, Nigeria's geographic location facilitates the application of the analytical framework to other Sub-Saharan countries that face similar problems, thus avoiding the shortfall of evaluating the evidence from a singular perspective. It is worth noting that these efforts were not intended to frame the issue in a predictive manner, nor did they attempt to answer *why* the casual relationships exist, but rather this project sought to establish an alternate method of analysis to understand *how* these relationships interact to complement the current approach to understanding the operational environment.

The research drew on data from the Uppsala Conflict Data Program (UCDP) and the Food and Agriculture Organization of the United Nations; these databases were selected primarily due to the comprehensive scope of their contents. The amount of data available between these sources enabled an appropriate depth of analysis to examine the context of the conflict in Nigeria across the entire spectrum of Homer-Dixon's model. Similarly, the user interface of these databases facilitated the replication of the study in Nigeria to other countries across the region and created the opportunity to expand the research in this study over time and space as the available information increases. The availability of historical data was enough to determine correlation and identify trends between the interaction of the environmental and social systems in Nigeria; however, the utility of this method is its ability to be replicated over time or in a different context.

Homer-Dixon's original model to correlate environmental degradation and conflict presents a wide aperture through which to view the conflict in Nigeria; this project narrowed the scope of his work in the interest of brevity as well as the absence of all seven "major human-induced environmental problem[s]" in the area of interest.<sup>27</sup> A study conducted in 2001 by the United States Department of Agriculture concluded that Nigeria was highly susceptible to human-induced desertification primarily due to the country's high population density and relatively low land quality.<sup>28</sup> The results of that study influenced the decision to focus the efforts of this project on the correlation between deforestation and conflict primarily due to the potential it offered to capture the beginning of the process through which land becomes converted for human use. In the case of Nigeria, deforestation provided an indicator of the initial stages of

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<sup>27</sup> Homer-Dixon, 88.

<sup>28</sup> "Land Resource Stresses and Desertification in Africa | NRCS Soils," accessed March 17, 2019, [https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/?cid=nrcs142p2\\_054025](https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/?cid=nrcs142p2_054025).

human-induced land degradation and created an opportunity to examine its correlation to conflict across the region.

### **Method of Analysis**

An evaluation of recent conflict trends in Nigeria reveals a steady increase in the level of fatalities attributable to intrastate violence over the past two decades. From Homer-Dixon's perspective, this increase in violence *should* be attributable to one or more major environmental effects. This study explored that line of reasoning by testing for a positive correlation between deforestation and conflict in Nigeria from 1991 to 2016. To be correct, the hypothesis required observation of increased fatalities in conjunction with higher levels of deforestation. Conversely, the prediction would be disproven if the findings revealed a weak or nonexistent correlation.

The assessment of the correlation between deforestation and conflict relied on the observation of trend analysis over a twenty-five year period. The design framework tested each relationship for statistical significance using the single factor analysis of variance (ANOVA) function in Microsoft Excel and the corresponding trendlines for each test were determined using polynomial trend analysis to account for the variation in fatalities recorded throughout the observation period.

The independent variable in this relationship was the level of deforestation that occurred throughout the period in question. This value measured the total amount of forested land in Nigeria expressed as a percentage of the total land area distributed between agriculture and forests. The number of fatalities for the corresponding calendar year served as the dependent variable in question. This metric captured event data gathered by the UCDP, which defines an event as "the incidence of the use of armed force by an organized actor against another organized

actor, or against civilians, resulting in at least 1 direct death in either the best, low or high estimate categories at a specific location and for a specific temporal duration.”<sup>29</sup> The categorization of fatalities by event facilitated a broad spectrum of analysis to capture violence regardless of the character of the conflict that triggered the event.

Levels of deforestation were determined to be the ideal measure of environmental vulnerability as a precursor to conflict in Nigeria due to several factors. First, Nigeria is the most populous country on the African continent and concerns regarding food security have the potential to impact land use practices.<sup>30</sup> Second, the prevalence of farmer-herder conflict in Nigeria suggests the impact competition for resources has on the various social, political, and economic systems in that country.<sup>31</sup> Deforestation is a measurable output of the processes that convert land for agricultural purposes, its selection as the independent variable for this study provides an opportunity to correlate the interaction of the threatened social systems outlined above with environmental security concerns.

## ***Results***

### **Context in Nigeria**

Figure 2 (see next page) demonstrates a positive correlation between deforestation and conflict in Nigeria and the available data suggests there is validity to Homer-Dixon’s hypothesis that major environmental effects contribute to conflict in developing countries.<sup>32</sup> Nigeria experienced a 60 percent reduction in its forested lands during the observation period in

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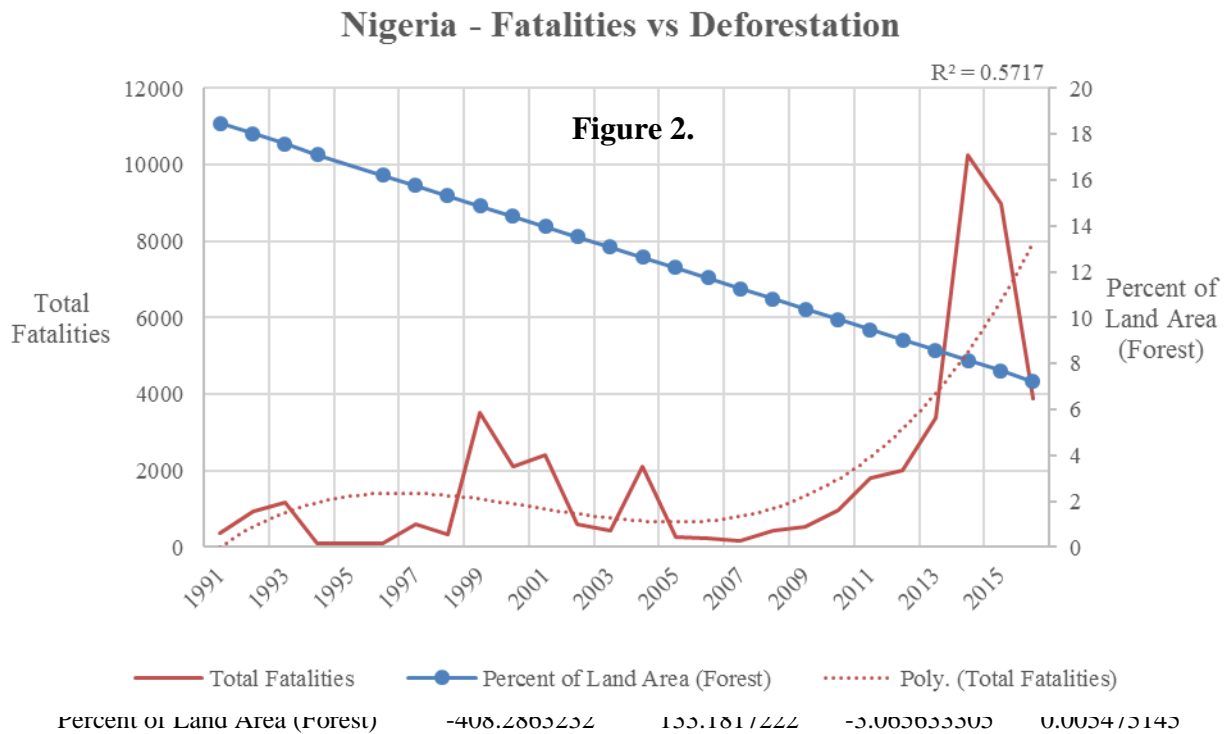
<sup>29</sup> Ralph Sundberg and Erik Melander, “Introducing the UCDP Georeferenced Event Dataset,” *Journal of Peace Research* 50, no. 4 (July 1, 2013): 523–32, <https://doi.org/10.1177/0022343313484347>.

<sup>30</sup> “Nigeria | Food Security Portal,” accessed April 30, 2019, <http://www.foodsecurityportal.org/nigeria/resources>.

<sup>31</sup> “Nigeria: The Harvest of Death - Three Years of Bloody Clashes Between Farmers and Herders in Nigeria” (Amnesty International Ltd, 2018), 6.

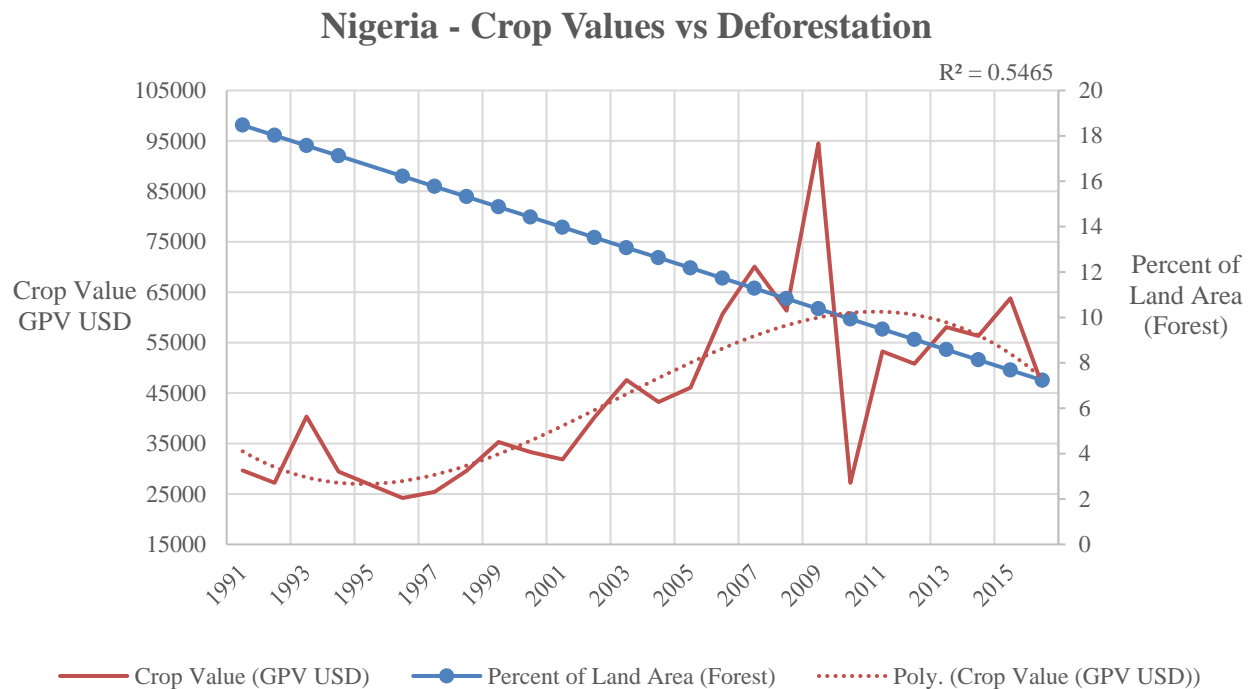
<sup>32</sup> Homer-Dixon, “On the Threshold: Environmental Changes as Causes of Acute Conflict,” 88.

conjunction with an incipient rise in fatalities due to intrastate conflict that grew exponentially toward the end of the reporting period.



In this case, the coefficient of determination for regression accounted for approximately 57 percent of the variance in this relationship. This value is not deterministic; however, the single factor ANOVA test shows the relationship to be statistically significant and worthy of further exploration. These results are not surprising given the complexity of the intervening variables contributing to conflict in Nigeria. However, the discovery of correlation in and of itself is not conclusive, but instead highlights the requirement for additional testing along the original line of inquiry.

Homer-Dixon’s method of analysis suggests that the correlation between deforestation and conflict should also manifest through one of the four primary social effects identified in the literature review, agricultural production, economic decline, population displacement, and disrupted institutions. This study applies that theory by assessing the value of agricultural production with respect to deforestation. The availability of data influenced the selection of this category as well as the fact that the metric captures two aspects of Homer-Dixon’s proposition regarding interactions between different social effects by assessing food production metrics as well as their corresponding economic value in parallel.



	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	18.59184	1.52116	12.22214	1.53E-11
Crop Value (GPV USD)	-0.00013	3.17E-05	-4.13288	0.000404

The results of this test are more difficult to interpret; initially, the value of Nigeria’s crop production rose in conjunction with a decline in forested land but beginning in 2009, after almost two decades of sustained growth, the values show a downward trend. From a statistical perspective, this correlation is significant, and the residual regression suggests that the data is a

good fit for the model in use. Pragmatically speaking, it stands to reason that crop values should increase as more forested land becomes available for agricultural production; the difficulty in this line of reasoning lies in determining the cause for the reduction in crop values despite a relatively steady rate of deforestation throughout the observation period. This idea alludes to Homer-Dixon's notion that in developing countries, "there is a policy trade-off between economic growth and environmental protection; this perception, in turn, encourages societies to generate present income at the expense of their potential for future income."<sup>33</sup>

The validity of Homer-Dixon's model relies on the interaction between a population, its environment, and the social effects produced by this iterative process.<sup>34</sup> One possible means for exploring this line of reasoning further is to examine the relationship between the dependent variables from each of the separate analyses conducted up to this point. The benefit of this method is twofold; first, examining these variables in concert facilitates a visual depiction of how they correlate with one another over time. Second, this comparison completes the informative process outlined by Homer-Dixon by framing the social effects of deforestation in a context that accounts for how they relate to conflict.

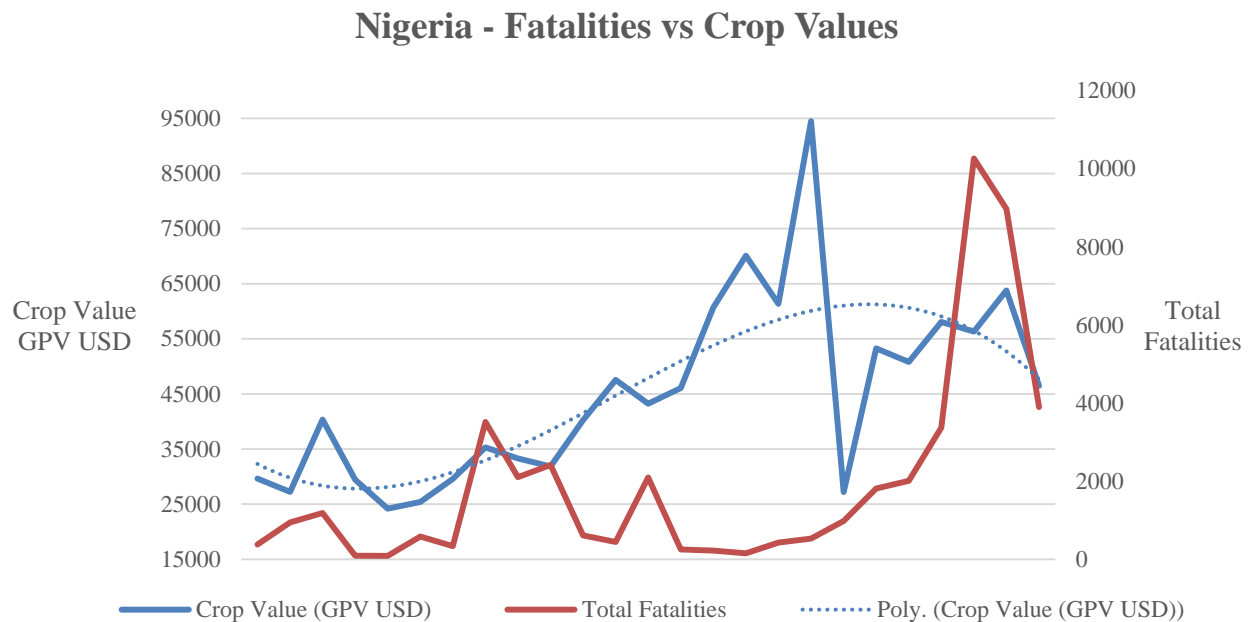
Figure 4 (see next page) illustrates the utility of the process outlined above, the results of a comparative representation suggest the decrease in crop values occurred roughly around the same time that Nigeria experienced an increase in fatalities due to intrastate conflict.

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<sup>33</sup> Homer-Dixon, 97.

<sup>34</sup> Homer-Dixon, 87.

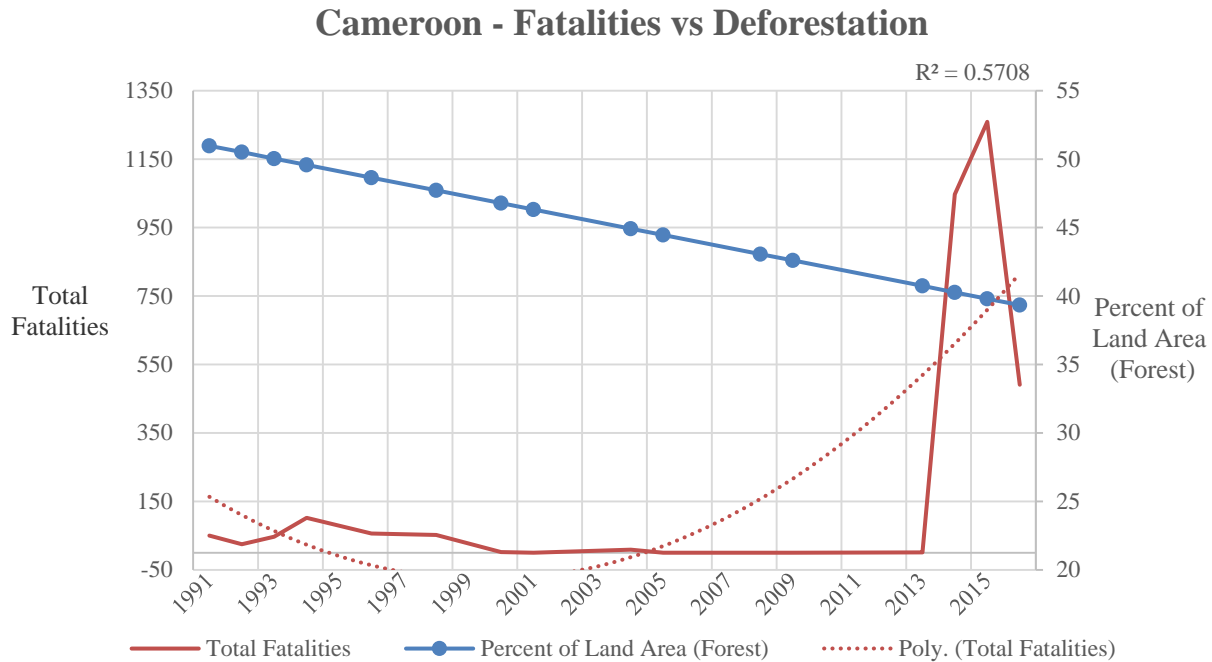
It is worth noting that these findings do not demonstrate causality due to the absence of a comprehensive examination of other intervening variables. They do, however, suggest that Homer-Dixon's model has applicability in the case of Nigeria and is worthy of exploration at a regional level.



**Figure 4.**

### Comparative Analysis

The replication of the preceding line of inquiry to other countries in the region produced mixed results with varying degrees of statistical significance. In Cameroon (see next page) the overall density of forested land decreased 22 percent during the observation period; as in Nigeria, these effects had a positive correlation with an increase in fatalities due to intra-state conflict over the same period. Unlike the approach taken in Nigeria, this project did not test the social effects of deforestation in Cameroon in order to facilitate a broader application of the first step of the analytical process to a larger number of countries.

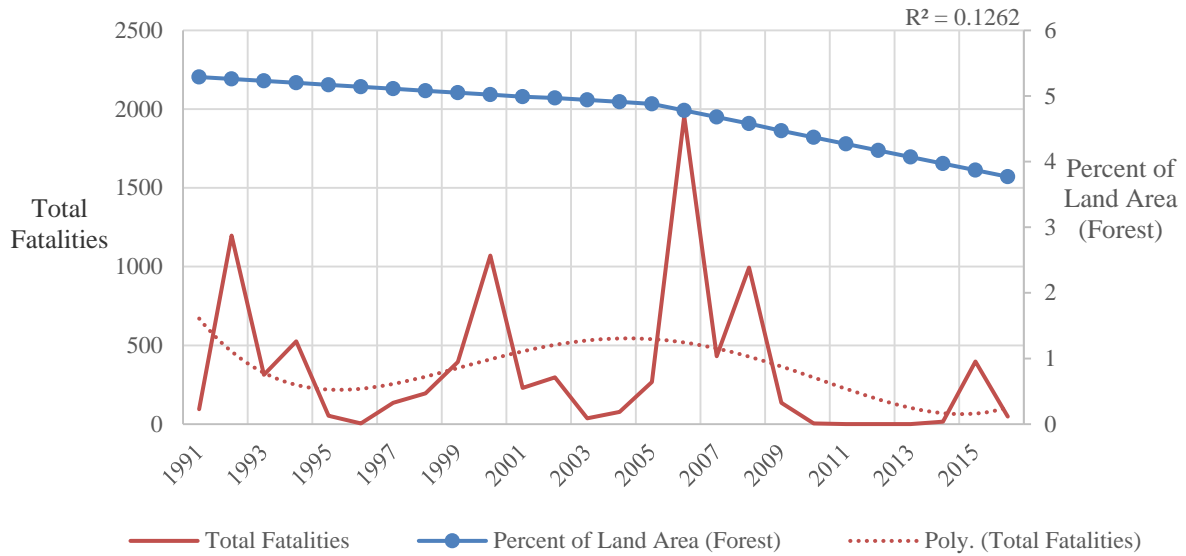


	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	2770.650197	963.0567753	2.876933393	0.012185
Percent of Land Area (Forest)	-56.75269458	21.15243316	-2.683033869	0.017839

**Figure 5.**

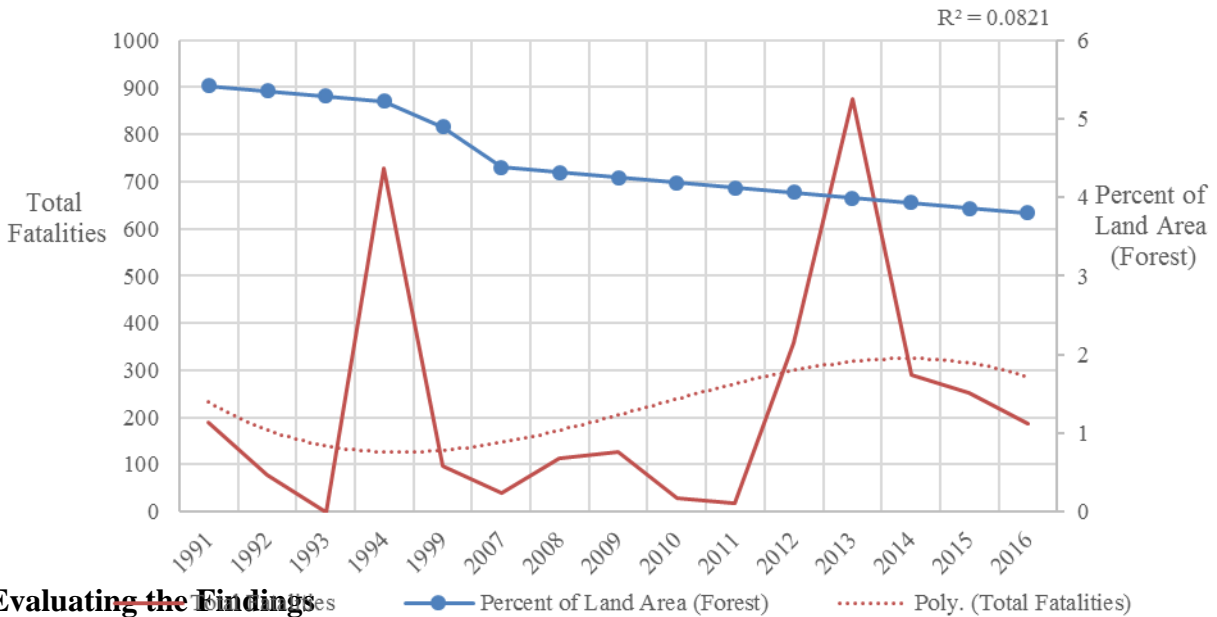
When applied to Chad and Mali, the model proves to be less predictive; in both cases, the correlation between the two variables is either nonexistent or otherwise lacking in statistical significance. Regional variance in the dependent variable may account for the lack of congruency in countries with low forested land density despite the presence of a positive correlation between deforestation and conflict. Furthermore, in each case, the levels of violence are considerably lower than those in Nigeria both in frequency and intensity. These results illustrate the analytical complications created by complex environmental and social systems despite efforts to constrain the contextual scope of analysis. This highlights the difficulty in universally implementing Homer-Dixon's model; each case requires a unique approach tailored to the interaction of the competing intervening variables in question.

### Chad - Fatalities vs Deforestation



	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	443.112	542.356	0.81852	0.427809
Percent of Land Area (Forest)	-48.668	120.080	-.405299	0.260636

### Mali - Fatalities vs Deforestation Figure 6.



Evaluating the Findings

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	-745.811	948.0005	-0.78672	0.439146
Percent of Land Area (Forest)	229.3337	199.0607	1.152079	0.260636

Figure 7.

The initial findings of this project suggest that Homer-Dixon's model is applicable in the case of Nigeria. The research design facilitates an evaluation of the correlation between the environmental and social effects in question and does so in a manner that depicts how they pertain to intrastate conflict. From an objective point of view, the results of each test in Nigeria are statistically significant, and the regression calculations indicate a good fit for the model in use. These results do not, however, determine any measurable level of causation in the relationships between the variables in question. This study merely replicates Homer-Dixon's method of analysis along a single line of effort and does not account for the influence of intervening variables.

A Strategic Conflict Assessment conducted by the World Bank in 2003 highlights the complexity of the factors contributing to intrastate violence in Nigeria; the report identifies the root cause of the problem to be political corruption while simultaneously recognizing the importance of other influences at the regional level.<sup>35</sup> The findings describe the majority of conflict as a result of tension between different ethnic and religious groups and highlight the impact of competition for resources across the state.<sup>36</sup> These conclusions illustrate the challenges inherent to an approach to understanding the operational environment from a limited perspective. As previously stated, a comprehensive analysis of the intervening variables in Nigeria is beyond the scope of this project; however, the research demonstrates the utility of framing an analytical approach around a single line of reasoning capable of expansion across multiple areas of interest.

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<sup>35</sup> Sarah Lyons and Dirk Reinermann, "Nigeria Strategic Conflict Assessment" (World Bank, 2003), 3–4, JSTOR, <http://www.jstor.org.lomc.idm.oclc.org/stable/resrep02468>.

<sup>36</sup> Lyons and Reinermann, 6.

The application of the project's initial assessment framework to other Sub-Saharan countries provided an opportunity to determine the applicability of the model in a regional context albeit on a relatively small scale. The results of that test produced inconclusive results, but the value of the findings is in what they did to inform the process rather than the statistical relationships they revealed. Organizing a line of reasoning based on the relationships posited by Homer-Dixon allowed the project to focus the core of its efforts on a single country of interest; in this case, Nigeria. The successive application of the initial case study to Chad, Mali, and Cameroon illustrated the utility of a test that is scalable to account for localized or regional variance in the relationships in question. In this case, the variables did not correlate with one another at the regional level; however, the design of the test facilitated a concentric application of the process from the core area of interest outward to better inform the understanding of how the initial variables in question related to the operational environment from a holistic perspective.

The results of this study demonstrate that awareness of the issues pertaining to environmental security enhances the understanding of the operational environment and contributes to the overall effectiveness of the operational approach. The following recommendations illustrate the necessary steps to account for these concerns in the current JIPOE process, none of which require extensive modifications to the existing framework.

Incorporating these considerations begins in the first step of the process; currently, the publication outlines one of the goals of *Defining the Operational Environment* to be determining its significant characteristics.<sup>37</sup> This process intends to provide an initial overview of the various qualities and characteristics of the OE; which implies the concept of identifying key relationships. However, the suggested areas of interest for the population tend to focus on

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<sup>37</sup> Joint Publication 2-01.3, *JP 2-01.3*, II-2.

cultural considerations.<sup>38</sup> Including a recommendation to determine how the population interacts with the environment sets the stage for the necessary analytical effort to examine the effects of these relationships in the subsequent steps of the process. This change forces the existing framework to go beyond merely defining the physical qualities of the environment and requires planners to consider how environmental conditions shape the normative beliefs and practices of the population.

The final recommendation seeks to alter the perspective of planners during the second step of the JIPOE process, *Describe the Impact of the Operational Environment*; the application of the study to this step of the process is twofold<sup>39</sup>. First, the geospatial understanding of the OE requires additional consideration as to how environmental effects shape the physical and locational aspects of the OE. The identification of environmental vulnerability in the first step of the process requires additional analysis regarding the influence of the physical characteristics of the OE, the location of the populace, and what implications those relationships have on military operations. The application of this change requires the addition of land degradation trends to the analysis of the land domain in step two of the JIPOE process.

The second aspect of this proposal centers around the approach to developing a systems perspective of the OE; in a sense, this recommendation is not a stand-alone process, but rather an incorporation of the outputs generated by the previous proposals to fully incorporate environmental security considerations into the JIPOE process. Improving this step is a matter of adding additional nodes and linkages to the existing systems perspective construct to account for the relationships identified in the previous two steps. The results of this study suggest the utility

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<sup>38</sup> Joint Publication 2-01.3, II-2.

<sup>39</sup> Joint Publication 2-01.3, III-1.

of these recommendations depends on the application of trend analysis; however, they are worthy of consideration even at a basic level of incorporation due to their ability to enhance the understanding of the operational environment from a holistic perspective.

### *Conclusion*

The sum of the effort across the case studies in this project lends credence to Homer-Dixon as well as his critics. On the one hand, the application of environmental and social system analysis in Nigeria yields predictive results; on the other, the analytical framework fails to produce repeatable trends across a broader cross-section of the population. If the goal of this project was to build a definitive means to determine causation in these relationships, it would have been a failure, but that was not the case. The methods outlined in the preceding sections serve to illustrate the potential for adapting contemporary social science research techniques in a military context. The tests conducted in this project did not explain why conflict occurs in Nigeria, nor did they demonstrate the degree to which deforestation influences the process. They did, however, offer an alternate means to consider how various environmental and social systems influence one another and what implications those relationships have on the understanding of the operational environment.

When viewed in comparison with the traditional PMESII construct, Homer-Dixon's analytical model demonstrates some striking similarities. The processes outlined within the Joint Intelligence Preparation of the Operational Environment establish the necessary framework for military planners to develop a contextual understanding of the operational environment that accounts for a broad range of physical and intangible factors in a sequential manner shaped by the iterative process of evaluation and feedback.<sup>40</sup> Homer-Dixon's model takes a similar

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<sup>40</sup> Joint Publication 2-01.3, I-5-I-7.

approach by creating the necessary framework to assess the complex interactions between environmental and social systems that shape the conditions leading to conflict. From a military perspective, the inherent value of the former method is its ability to frame the efforts to determine *what* the critical relationships in the operational environment are whereas the latter fosters the pursuit of a deeper understanding of *how* they interact.

Incorporating environmental security considerations into the existing approach to understanding the operational environment enhances the effectiveness of the current process. The addition of the recommendations outlined above provides a seamless update to a proven method of analysis requiring only minor modification to the training and education necessary to achieve its fullest potential. The JIPOE process enables military planners to make sense of complex operating environments; this study demonstrates the utility of leveraging parallel efforts in the private sector to enhance the efficiency of that process.

The results of this study are inconclusive at best; the scope of the effort was not commensurate with the complexity of the conflict in the countries in question. That said, the complexity of current and future operating environments is not likely to diminish at any point soon. This project demonstrated the potential for the application of social systems theory in a military context to develop an understanding of the operational environment informed by statistical analysis. These efforts are worthy of future consideration and warrant investigation at a larger scale to further test the findings illustrated by this project and others like it.

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