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Agriculture, Grains and Beef Production: Remedies for Food Insecurity and the Ecological Footprint When the Cataclysm Comes?

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Abstract

Recently the World Bank and United Nations have predicted a cataclysm of overpopulation that will lead to global starvation (and environmental collapse) in the next ten to thirty years. Recommendations are broadly made that food insecurity can be resolved through substantially increased industrial agricultural production of cattle (for edible beef) and grains for undernourished populations. We test these assertions with data from the Food and Agricultural Organization (FAO). We focus on the world system with attention to the poor periphery of that whole. Structural Equation Modeling is our technique of choice for examining key causes among the 87 countries best suited to the regression equations derived. Others with missing data or having "outlier" status remain for a study of "maverick" cases. Results suggest that the past reports of the World Bank and United Nations are likely to be incorrect. The findings here are in line with our previous work and the very recent and revised opinions of the world's two great global organizations.

Keywords: World system; Urbanization; Industrial agriculture; Waste; Cereals; Cattle for meat; Food insecurity; Environment; Ecological footprint

Introduction

Long ago demographer Thomas Malthus said population grows exponentially while societal production only grows arithmetically. This difference spurred Malthus to predict population growth would outstrip production leading to mass starvation and death globally. The World Bank and United Nations say this cataclysm will occur between 2030 and 2050, depending on a range of factors. Eight hundred million people already live in hunger. The World Bank predicts climate change could cut future crop yields by more than 25%, suggesting far more grain will be required. The Food and Agricultural Organization of the United Nations (FAO) in turn says 465,000.000 tons of meat will be needed by the year 2050. However, the authors emphasize that we must also attend to global waste. Each year the world produces close to 212 billion tons of waste, extracting the equivalent of 1.7 planet Earths in order to continue the pace of our consumption. Moreover, since waste contributes to global warming through the release of methane and other toxins, it directly contributes to serious climate events (hurricanes, typhoons, tsunamis. flooding, and so on) that further compromise food supplies. Landfilled waste also contributes to soil pollution, further limiting food production. Thus, the management of waste is another key to producing food security. The authors use structural equation modeling to find cause and effect parameters for food insecurity hypotheses. These hypotheses are taken from our prior work Kick, Zering, and Classen 2015; Kick, Tiezzi, and Pena 2018) and reviews of the relevant literatures in economics, sociology, geography, political science, and agriculture.

Materials and Methods

The methodology employed is structural equation modeling (SEM), a technique developed by O.D. Duncan [1] and used with increasing frequency in the sciences [2,3]. It permits the assessment of the magnitudes of direct and indirect causations, and indirect measurement by multiple proxies or factors for those variables that are otherwise unmeasurable (e.g., intelligence) or difficult to measure (e.g., food insecurity). The data source for most variables is the Food and Agriculture Organization of the United Nations (v.d.). Data for the measurement of world-system position (of power) is enumerated at length by Kick, McKinney, McDonald

and Jorgensen [4]. The sample is comprised of 87 countries that are structurally differentiated by their clustering into blocks of countries that are structurally similar in their degree of power over other nations (i.e., the "core" block of the US and Western European countries; the "periphery" blocks of the weakest countries of the world including Africa, Southeast Asia and Central and South America; the "semi periphery" blocks of countries that fall in between the core and periphery in global power across the multiple dimensions of economics, military exchanges, cultural links and diplomatic oversights (e.g., China, India, Eastern Europe, Russia. Argentina. South Africa).

Results and Discussion

Correlations among the indicators and substantive variables form a dizzying patchwork that with descriptive statistics is eliminated from this paper. However, interested readers may obtain these statistics from the corresponding author. Results of the SEM estimations are displayed in Figure 1. An initial finding that is not presented due to reasons of space is the biome(s) of a nation, which affects the nation's international power (the better the biome for growth of a range of natural resources, the greater the national power). Lush environs aid food production and the power of a nation over others. Presented is the finding that the greater the international power of a nation, the lower is its food insecurity. Nations with power grab more of the distribution of the world's resources, while weaker nations are unable to fully control their own resources, which commonly are owned, processed, finished and marketed by outside corporations from the core nations. This logic has supplanted the logic of direct and expensive colonial ownership.

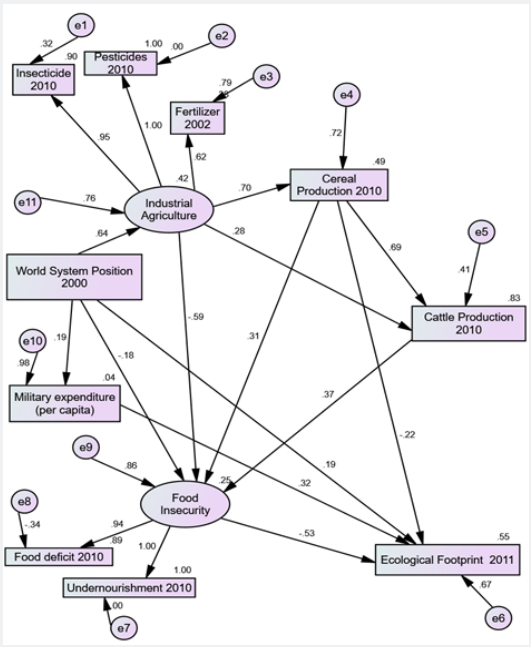

Figure 1: SEM diagram of Food Insecurity and Ecological Footprint..

Both circumstances of the biome and global power (WSP) impact the many domestic capitals countries can draw upon to improve the conditions of their life. While estimates of the effects of these capitals are too numerous to report here, they include their ability to garner food (e.g., natural capital --Earth's resources), human capital, social capital, political capital, economic (financial) capital, built capital (infrastructure), and cultural capital [5]. While each capital tends to impact the others in a favorable direction, several stand out in inducing food security. Economics aids the state in acquiring outside resources to produce food. Democratic political systems are a key element in the equitable distribution of food since authoritarian governments in the non-core may hoard food to maximize their control over financial capital in times of food scarcity (e.g., in the past the Philippines and Haiti). Built capital, such as infrastructure related to roadways, canals, railways and airlines, permits food to be distributed to distant regions among wealthier, core countries only. Limitations to infrastructure characterize the periphery and to a lesser degree the semi periphery, thus restricting the distribution of foodstuffs such as grains and beef to more remote areas of the country. In addition, other peripheral and semi peripheral states may offer these food stuffs to certain segments of the population with which they are politically aligned, and intentionally starve out oppositional groupings in other parts of recipient nations (in recent times Saudi Arabia's selective donations of resources to one segment of Yemen with which they are allied, and disregard of other parts of Yemen that are viewed as oppositional. Natural capital offers the bounty of the Earth to the population if they

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can acquire it in the face of obstacles, such as outside and inside contenders for resources.

WSP also leads to significantly higher levels of industrial, agricultural production (Figure 1; beta=.64). Core nations have become service economies, nevertheless they, along with a segment of the semi periphery, remain as global powerhouses in industry. The technical wherewithal of the core permits innovations in machinery and chemicals, among other sectors, that impact the sheer volume of food produced if not the variety. Since around the year 1960 the United States has moved so rapidly in farm-related technology that each year about 1% of farmers fall off the treadmill of farm production, moving almost three-quarters of agricultural production to monocrops grown on huge acreage with sophisticated (albeit sometimes dangerous) chemical applications and specialty farming equipment that astounds in function and price. For the present, monocrop agricultural production has aided survival in much, though certainly not all the world. Estimates vary but somewhere between 750,000,000 to 1 billion people are without adequate food and nutrition, access to clean water, and nearly double those figures go without adequate sanitation. Core position in the world system also leads to greater expenditures on domestic militaries, as well as militaries abroad (beta=.19). Figure 1 shows that both WSP and military expenditure degrade the environment or ecological footprint (respectively, betas=.19, .32). As illustrations, core countries and their militaries damage or eliminate forests and fresh water, and military expenditures on equipment (tanks, jets, rockets, and so on) have an impact on carbon production, and flora and fauna as well [6].

Model Fit Evaluation

Chi-square: 84.74, df=27, sig=.000, ratio=3.139

Goodness of fit measures:

a) NFI: .919

b) RFI: .834

c) IFI: .943

d) TLI: .881

e) CFI: .942

Interpretation of model fit:

The chi-square statistic, while significant (which is not desirable) has an acceptably low chi-square to degree of freedom ratio of 3.139. The goodness of fit measures should approach the upper limit of 1.00, and we see that they are all acceptably high.

It is interesting that industrial agriculture greatly impacts cereal production in a favorable way (beta=.70), and to a lesser extent cattle production (.28), but while industrial agriculture benefits food security, both cattle and cereal production have a moderate depressing effect on food security (that is, a positive impact on food insecurity). These effects are unfortunate in the extreme. These are very important types of food production and major international organizations have counted on upticks in their production to stave off the predicted cataclysm in the next ten to thirty years. We must note, however, that the more recent opinions expressed by the major world organizations have begun to question whether these sources are able to offset Malthusian dynamics of overpopulation. The rather strong impact of cereal production on cattle is what one would expect, given the role of cereal in the diets of bovines. However, the absence of favorable effects of cereals and beef on universal humanity does not lend itself to immediate explanation. We reason that it is possible that the exports of these two items in non-core settings may contribute directly to their absence in the diet of nationals. Global markets and pricing may draw both smaller-time farmers and industrial farms in the non-core to look for external markets rather than internal ones, leading to domestic food insecurity. When taken with government hoarding, it is rather easy to speculate about how the draw of financial capital may be more attractive than saving fellow nationals from starvation and death.

A more positive observation is that the production of cereals feeds cattle and dampens the ecological footprint, even though it does not help humans in their quest for food security. Opinions differ in efforts to account for environmental improvements attending cereals production over recent decades. Some scholars contend that gains in select countries from the Green Revolution may explain a selectively reduced impact on Earth's ecology. With respect to wheat, rice, and maize, idealized solutions include even more sophisticated management practices about soil, water, and applied inputs. SEM coefficients clearly show that food insecurity is of great benefit to the ecological footprint. Thus, while production management may be helpful, it is somewhat more plausible that control over waste management will be a preferable alternative. For instance, the government in France penalizes food stores for food wastage. A concrete illustration in the US is the disposal of milk products as the shelf date approaches, even though weeks may remain on the "safe food" clock. The authors have known student colleagues who routinely eat lunch and supper from McDonald's trash bins, which is suggestive about US payments to laborers in both blue and white collars, but also the routine practices of fast-food chains.

Conclusion

This research argues that only nations who are globally powerful, surrounded by the most productive biomes, have the strongest economies, are governed by fully democratic systems and have well-developed infrastructures can offer their populations food security. Poorer nations nearer the bottom of the world system in power tend to have the opposite characteristics, including food insecurity. Results from the structural equation estimations show the production of the most important grains and cattle is negatively related to food security, although overall

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agricultural production in the industrial mode has a quite favorable effect. The commodities once favored by major international organizations do not "deliver" according to our results, or to the most recent publications of these organizations. The findings also show that the extent of environmental damage, shown by the ecological footprint, is rendered worse by the powerful nations of the world. The footprint also is worsened by military expenditures per capita, a characteristic of the same group of powerful core nations, as well as the militarily powerful states of the semi periphery. Cereal production is a favorable type of production about the environment. What remains for study is those foods produced that jointly enhance food security and the ecological footprint. An agenda such as this is strongly recommended by the findings of this research treatment.

We also strongly recommend the technique of structural equation modeling, as a preferred technique to regular linear multiple regression models. Most parameter-producing efforts such as ours use conventional multiple regression techniques in which a line of regressors such as ours are judged for their independent effects net of others in the lineup. All too often the betas produced are signed in the opposite direction of their sign in the correlation matrix. Also, the betas all too often exceed unity ("1"). Further, the signs of coefficients are exactly opposite to the ones postulated, or to other quite similar variables in the equation. The malaise common to these sorts of findings is "multicollinearity," detected or not, but typically present in efforts that include variables that commonly are essentially duplicates of one another. This can be judged by inspection of all the above conditions, or by use of standard multicollinearity detection devices. The latter are an easy way of determining whether the regression analysis has a redundancy in the predictor variables. Independent variables that can affect parameter estimates or standard errors (significant levels). To put it technically, multicollinearity, also collinearity, occurs when one predictor variable in a multiple regression model can be linearly predicted from the others with a substantial degree of accuracy. That is, when two or more are redundant with each other. An easy test is provided by the Variance Inflation Factor, which some say should say should not exceed "2." Others say "5" is the absolute maximum. One very popular treatment of the ecological footprint appears to employ a boundary of "8" instead, and we question the validity of the findings reported. We also worry about a range of other problems with the study [7]. That said, we urge that due caution be exercised in interpreting the results in cross-nation multiple regression studies. However, we hope researchers adopt research designs that permit the examination of multiple measures of sustainability. Here we used food insecurity and the ecological footprint. Several other combinations come to mind. For suggestions we refer readers to the variety of data available in the FAO dataset [8].

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