Nation State Food Security: A Simulation of Food Production, Population Consumption, and Sustainable Development

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I. Introduction

The topic of food security has been deliberated by scores of individuals over the last two centuries. Since Malthus first published his 1798 paper titled "Essay on Population," the world food equation has commonly been viewed as a race between food and population. For Malthus, the prognosis was bleak with famine, pestilence, and war outbreaks taking place for the reason that "population, when unchecked, increases in geometrical ratio. Subsistence increases only in an arithmetical ratio." [1] A century later, Sir William Crookes' food scarcity prediction, that all civilized populations would outstrip the expansion of food production by 1931, was refuted by Joseph S. Davis who emphasized "the wheat problem of 1931 was one of world surplus, not world shortage, actual or impending."[2] Of late (1998), Frances Moore Lappé reexamined the world hunger situation, identifying "twelve myths" surrounding food scarcity with a focus on policies for redistributing world production.[3]

[1] John W. Mellor and Bruce F. Johnston, "The World Food Equation: Interrelations Among Development, Employment, and Food Consumption," *Journal of Economic Literature*, Volume 22, Issue 2 (June 1984), p. 532.
[2] Ibid. See also Joseph S. Davis, "The Specter of Dearth of Food: History's Answer to Sir William Crookes," in *On Agricultural Policy 1926-1938* (Stanford, CA: Stanford University Press, 1939), p. 4.
[3] Frances Moore Lappé et al., *World Hunger: Twelve Myths* (New York, NY: Grove/Atlantic, Inc., 1998).

Environmental men and women – a recognizable elite contributing research to organizations such as the Worldwatch Institute, the Institute for Food and Development Policy (Food First), the World Bank, and universities – dominate the recent discussion over sustainable food production and population expansion. Essentially, there are three main camps, as presented by Homer-Dixon, to the active debate over food distribution and whether the expansion of food production can keep pace with population growth. *Malthusians*, who are often biologists or ecologists, claim that finite natural resources place strict limits on the growth of human population and consumption; if any of these limits are exceeded, poverty and social breakdown result. Many *neoclassical economists*, in contrast, say that there need be few, if any, strict limits to human population, consumption, and prosperity. Properly functioning economic institutions, especially markets, provide incentives to encourage conservation, resource substitution, development of new stores of scarce resources, and technological innovation. Finally, analysts referred to as *distributionists* acknowledge that there may be resource limits to human population growth, but for them the real problem is the maldistribution of resources and wealth. Poverty and inequality, in their view, are the cause, not the consequence of high population growth rates and practices that deplete resources.[4]

Given the Malthusian, neoclassical, and distributionist approaches as contrasting points of departure, the goals of the present paper are:

1) to develop and evaluate a system dynamics food security model based upon a combination of Malthusian, neoclassical, and distributionist

[4] Thomas Homer-Dixon, "The Ingenuity Gap: Can Poor Countries Adapt to Resource Scarcity?," *Population and Development Review*, Volume 21, Issue 3 (September, 1995), pp. 587-588.

methodologies as they are used to study nation-state food security behavior in a complex global arena; and

2) to infer from the evaluation of this model some implications, or insights, for food security policies.

Our research is heavily grounded in the theory of nonlinear dynamics and feedback control originally developed in mathematics, physics, and engineering. Utilizing system dynamics methods and tools, we seek to explain interactions between nation states by phenomena such as their prior behavior within the structure of interrelated political, economic, and ecological systems. Because learning about these complex systems requires more than technical tools to create mathematical models, dynamic simulation will be utilized to bridge the physical and technical sciences with the cognitive psychology, economics, and environmental specializations of the social sciences.

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