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TABLE OF CONTENTS

LIST OF FIGURES

ABSTRACT

In 1943 the Rockefeller Foundation, nominally in partnership with the Mexican government, initiated its Mexican Agriculture Program (MAP). Over the subsequent decades, a complex network of worldwide inter-governmental/NGO relationships was formalized along the model developed in Mexico. The dissemination of this research-educational model of agronomic "rationalization" to much of the Global South became retroactively known as the "Green Revolution." This paper argues that this imposition of "rational" agronomy and agricultural economics through mechanization, monoculture, and synthetic inputs is constitutive of "epistemic colonialism." Despite the attention paid to the Green Revolution as an agronomic undertaking, using economics and anthropology case studies (1965-1979), this thesis argues that the Green Revolution was a both a technoscientific intervention and a social scientific intervention in indigenous Mexican agricultural knowledge making that combined to form a *development regime*. This co-produced development regime was embedded in a hierarchical set of nested co-productive relationships with Mexico's desire to modernize through urbanization and national identity formation and with the United States' Cold War geo-political strategy of pseudo-territorialization for the creation of a liberal-democratic capitalist bastion against Soviet expansion.

Introduction

Vandana Shiva uses the metaphor of the "monoculture of the mind" to create an illustrative parallel between the losses of both epistemic plurality and biological diversity. In her 1993 *Monocultures of the Mind* she crafted that ecofeminist metaphor for both activist and scholarly purposes. Much of *Monocultures of the Mind* is grounded in historical events and has been widely circulated with acclaim among those operating in Science and Technology Studies (STS), but it is not formally a disciplinary history of science and technology.[1] In a fashion less literary than Shiva, this thesis depicts an historical period between 1943 and 1979 in which mental monocultivation, in this case the supplanting of indigenous Mexican epistemologies by the Northern technoscientific episteme, and botanical monocultivation are packaged together.[2] This particular packaging, to history, is called the Green Revolution, although that reference must be used in full acknowledgement of the scientific triumphalism that it was originally coined to herald in 1968 by William S. Gaud, then director of the U.S. Agency for International Development. Despite its drawbacks, "Green Revolution" at least has

[1] In this thesis I will use Northern rather than Western, "developed," or "industrialized" because it is currently considered to be the least value-laden. Northern refers to the Global North, considered in Global and International Studies to represent continental North America north of the U.S.-Mexico border, Europe (including Russia and Turkey), Japan, Australia, New Zealand, and occasionally South Korea and Kazakhstan.

[2] I do not see any internally-consistent rationale to make a categorical distinction between science and technology. That categorical distinction, characterizing technology as the practical application of theoretical science, reifies the dichotomy of mind and body in the Northern episteme, and is usually employed, again as boundary work, to subordinate technical thinking to epistemic thinking. For the marginalization of empirical *techne* (what Marglin calls labor's knowledge) by positivist *episteme* in the history of Northern knowledge making see: Stephen Marglin, "Towards the Decolonization of the Mind," in *Dominating Knowledge: Development, Culture, and Resistance*, eds. Frederique Apffel Marglin and Stephen Marglin (Oxford: Oxford UP, 1990), 24-25.

Indigenous here used indiscriminately sometimes to refer to native peoples of Mexico and sometimes to all Mexicans. With native peoples of Mexico, they are indigenous relative to culturally-european mestizo and european population, with Mexicans, they are indigenous to Mexico from the perspective of Americans. This indiscriminate labelling is one of the obvious injustices of the paper; I was unable in this project to perform my analysis with that degree of categorical discrimination.

fewer syllables than "The Second or Third Agricultural Revolution."[3] In either case, its grandiosity and impact are fully represented. Also for its grandness and impact, the Green Revolution has been thoroughly studied by historians of science and technology. For that reason, this thesis does not attempt to replicate the histories of science and technology that have so admirably studied the plant pathologists, entomologists, geneticists, soil scientists, and others working to deliver the technoscientific package of hybrid seeds, fertilizers, biocides, and machinery to Mexican farmers.[4] Instead, I focus on the role development-oriented and -critical economists and anthropologists played in the Green Revolution intervention in Mexico. I argue that the work of social-scientists in Mexico in the 1960s and 1970s constituted a social-scientific intervention in Mexican agricultural knowledge-making; that this social-scientific intervention in conjunction with the technoscientific agronomic intervention co-produced a development regime; and that this regime should be regarded by historians as a case of epistemic colonialism.

When the Green Revolution was initiated in Mexico in 1943, the virtue of the proposed epistemic monoculture was nearly unquestioned in Northern international policy academic circles. They insisted upon the inexorable universality of reductive mechanistic thinking (and its method) under the rubric of modernization theory, the belief that the mental monoculture of Northern technoscience should be transplanted to other knowledge ecosystems. By the late 1970s, however, scholars both North and South were questioning not only specific applications of modernization theory in the South, such as development regimes like the Green Revolution, but the inherent

[3] For the curious: The first agricultural revolution was the shift from foraging and/or pastoralism to sedentary cultivation; the second, depending on categories disputed by historians of agriculture, either refers to the Green Revolution or one of several significant developments anywhere from the early medieval period (in the Arab world), or the high Middle Ages in Europe, to 19th-century Britain, indicating various combinations of changes in field rotation, plowing technology, and irrigation.

[4] "Biocide" is shorthand for pesticide/insecticide, herbicide, and fungicide.

validity of "modernization" theory and its attendant nexus of liberal democratic government, rationalized bureaucracy, technoscientific industry and agriculture, and global commercial capitalism. Some of those critics began to recover and articulate-anew alternative epistemologies marginalized or rendered invisible altogether by the expansion of the Northern episteme that began with 15th century colonization, of which the Green Revolution was an extension. These alternative epistemologies can be considered under the heading coined by Boaventura de Sousa Santos, the Portuguese sociologist of law and economist: "epistemologies of the South."[5]

This thesis also argues, then, that the Green Revolution, despite the excitement of science triumphalists about hybrid seeds, exponential yield increases, and the salvation of the pitiful masses from starvation, was in its essence, in both its theoretical premises and controversial outcomes, a social scientific phenomenon. This thesis argues that the lifecycle of the Green Revolution, and by consequence that of modernization theory of which it was the exemplar, can be most clearly traced through the social science literature from 1965 to 1979. At the beginning of this period social scientists were uncritically using the Green Revolution as a test case in modernization theory and optimizing it for export to any Southern nation that would co-sponsor it. In the early 1970s social scientists began to address the by then undeniable socioeconomic and ecological shortcomings of the Green Revolution by questioning the neutrality of its technologies and reassessing its implementation. By the end of the 1970s, social

[5] Boaventura de Sousa Santos, *Epistemologies of the South: Justice Against Epistemicide* (New York: Routledge, 2016). These alternative epistemologies, in recent literature, have also come to include what might be called "folk" knowledges from the North, long coevolving with the now dominant technoscientific episteme and slowly marginalized inversely with, and through boundary work by, the ascendancy of the technoscientific episteme. One such alternative knowledge system indigenous to the North is described by Stephen Marglin as *techne* — a decentralized empirical way of knowing cultivated by agriculturalists and craftspeople. Stephen Marglin, "Farmers, Seedsmen, and Scientists: Systems of Agriculture and Systems of Knowledge," in *Decolonizing Knowledge: From Development to Dialogue*, eds. Frederique Apffel-Marglin & Stephen Marglin (Oxford: Oxford UP, 1996).

scientists had begun, through their studies of the Green Revolution, to question modernization theory itself and its assumptions about time, labor, and value. Their Green Revolution studies also led them to question the universality of the Northern episteme's mechanistic and reductive causality.

Selected Historiography of the Sociology of Dominant and Subaltern Knowledges

The Green Revolution was both an extension of the old colonial project to expand the Northern episteme dating back to Spanish Catholic missions and schools in Mexico and, particularly to its time period, a hallmark instantiation of the Cold War neocolonial project of modernization theory. This thesis attempts to understand the Green Revolution through its transition in the opinions of social scientists during the late 1960s and 1970s from paragon of American international modernization theory to modernization-theory-crisis ground-zero. In the twenty-first century modernization theory is still being enacted under various pseudonyms by proponents of Northern-style (agro-)industrial development and so, consequently, philosophers, sociologists, and public intellectuals continue to challenge the intellectual and historical foundations of the expansion of the Northern episteme. One form these challenges take is the reaffirmation of non-Northern ways of knowing.

One such epistemology of the South, put forward by De Sousa Santos, Joao Arriscado Nunes, and Maria Paula Meneses (the latter colleagues of De Sousa Santos at the University of Coimbra, a sociologist and an anthropologist, respectively) calls for an "ecology of knowledges" to replace "the monoculture of scientific knowledge" in "Opening Up the Canon of Knowledge and Recognition of Difference," the introduction

to an edited volume entitled *Another Knowledge is Possible*.[6] This ecology of knowledges represented in the anthology consists both of Southern epistemologies external to "science" (previously considered invalid for their "superstition" and "traditionalism") and of the "internal plurality of science" established by feminist and post-colonial scholars and by historians, sociologists, and philosophers of science and technology. This internal plurality of science, for de Sousa Santos, Nunes, and Meneses incorporates the social construction of technoscientific knowledge and challenges the constant policing of the boundaries of science against other Northern ways of relating to the world dismissed as irrational, emotional, and unsystematic (Northern religion, arts, and humanities).[7] De Sousa Santos et al.'s ecology of knowledges, in a sense, performs *boundary leisure*, that is, the opposite of boundary work, in its inclusion of the Northern socially-constructed and -situated technoscientific episteme, the North's religious, artistic, and humanistic ways of knowing, and Southern epistemologies. When the Green Revolution unraveled in Mexico in the late 1970s, social scientists in close contact with Mexican farmers began to question the universality of technoscientific agronomy and reaffirm the value of indigenous Mexican ways of knowing. At the same time, Northern scholars of science and technology began substantiating science's and technology's social construction in earnest.

In the same way that de Sousa Santos et al. see their ecology of knowledges as the expansion of epistemic options, Stephen Marglin, inversely, sees monolithic Northern-style development as the contraction of choice in many domains. In some domains, Northern modernization does expand choice, but falls far short of its

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[6] Boaventura de Sousa Santos, Joao Arriscado Nunes, and Maria Paula Meneses, "Introduction: Opening Up the Canon of Knowledge and Recognition of Difference" in *Another Knowledge is Possible: Beyond Northern Epistemologies* (New York: Verso, 2007), xx.

[7] De Sousa Santos, et al., "Opening up the Canon of Knowledge," xxx.
Thomas F. Gieryn, "Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists," *American Sociological Review* 48, no. 6 (Dec. 1983).

promises. In consumerism, democratic government, and secularism, Northern-style modernization claims as one of its virtues the expansion of choice as liberation from the choice constraints of subsistence scarcity, authoritarianism and traditional dogmatism. The delivery of a development package, such as the Green Revolution, is often construed as the presentation by the development agent to the Southerner of a choice between the agent's Northern way of knowing and doing and the Southerner's, but Marglin points out that when the imposition of a new choice displaces or eliminates extant (and more numerous polycultural) choices, Southerner's options contract. When Southern knowledge, often maintained through the practice of craft and intergenerational knowledge transmission, is displaced in one generation, it is lost and can no longer exist parallel, and as an alternative, to the Northern way.[8] As Shiva says of this irreversible forced contraction of choice, if Northern science were universal, it would "spread in openness," and would not depend on coercion and the misrepresentation of other local knowledges as "primitive" and "unscientific."[9] Instead, in Shiva's reckoning, the Northern technoscientific episteme is a local culturally-particular epistemology like any other, globalized by force not by inherent universality. Like de Sousa Santos, et al. and Shiva, Marglin advocates for a diversity of knowledges, in our own self-interest and in the global interest, with an argument from uncertainty. When unforeseen twenty-first-century crises arrive, like a blight to a monocropped field, we will wish we had as many problem-solving approaches as possible, — at which

[8] Stephen Marglin, "Towards the Decolonization of the Mind," in *Dominating Knowledge: Development, Culture, and Resistance*, eds. Frederique Apffel Marglin and Stephen Marglin (Oxford: Oxford UP, 1990), 4-6.
[9] Vandana Shiva, "Monocultures of the Mind," in *The Vandana Shiva Reader* (Lexington, KY: UP of Kentucky, 2015), 72.

point, "it would be a cruel irony to find the world remade in our own image" — bereft of the resiliency of polyculture.[10]

The repeated inclusion of Northern epistemologies in nascent Southern pluralist epistemologies, despite what would have been an understandable revanchist animus among Southern and Southern-sympathetic intellectuals, is consistent throughout these contemporary sociologies of knowledges and proposed epistemologies of the South. One such proposal is to hybridize subaltern and dominant epistemologies into "border thinking," as Walter Mignolo convincingly does in *Local Histories/Global Designs*. Contrary to the totalizing colonial influence of the technoscientific episteme, Mignolo, with his border thinking, is "not attempting to find the only and correct concept that captures the 'thing,' the (master) empty signifier that will house the entire diversity of particulars."[11] To pretend to universality and singularity as the Northern episteme does would, for Mignolo, change the content (Southern instead of Northern) without changing the terms (totalizing) of the conversation. Instead, rather than to dominate, border thinking, arising from the myriad geographically-dispersed "wounds of colonialism," is inherently "universally marginal, fragmentary, and unachieved." What would be considered in the Northern episteme a failed attempt at systematization and horizontal integration prevents border thinking from stooping to totalizing "ethnocide."[12]

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[10] Marglin, "Decolonization of the Mind," 16. David Wade Chambers and Richard Gillespie put it similarly in their "Locality in the History of Science." After the twentieth century's completion of "a half-millennium of global multi-cultural engagement, marked principally by conflict and holocaust," they suggest that by "helping preserve the multiple varieties of human understanding of the natural world" we can "improve the possibility of constructive cultural reconciliation in a deeply troubled world." David Wade Chambers and Richard Gillespie, "Locality in the History of Science: Colonial Science, Technoscience, and Indigenous Knowledge," *Osiris: Nature and Empire: Science and the Colonial Enterprise* Vol. 15 (2000), 221-240.

[11] Walter Mignolo, *Local Histories/Global Designs: Coloniality, Subaltern Knowledges, and Border Thinking* (Princeton, NJ: Princeton UP, 2012), 66.

[12] Mignolo, *Local Histories/Global Designs*, 68.

That, in service to modernization theory, science could be party to ethnocide is puzzling to many Northerners inculcated in the Northern mode of understanding and organizing the world.[13] Vandana Shiva sheds light on their believed immunity of science from the violence of which it is accused. The Northern knowledge taxonomy is composed of inter-referential assemblages of dichotomies: nature/culture, mind/body, masculine/feminine, and, under Shiva's microscope, fact and value. According to this dichotomy, violence is situated in the realm of values, a byproduct of politics and ethics — if related at all to science and technology, only as an unintended consequence of a misapplication of science and technology. Science and technology are insulated from the violent ramifications of these misapplications by their supposed neutrality. Technoscience seeks asylum by inhabiting the realm of fact.[14] This insistence on technoscience's inherent neutrality will surface repeatedly in this thesis: at the beginning of the Green Revolution's instantiation in Mexico, incredulous planners and quality-controlling social scientists placed the onus of blame for the Green Revolution's slow gains on Mexican campesinxs, then on uncooperative socio-cultural and institutional arrangements resistant to agronomic, insurance, and commodity pricing adjustments. As the 1970s waned questions mounted about the neutrality of the technoscientific package itself, and then, only toward the end of the story, in the late 1970s coincident with the rise of social constructivism in science and technology studies, would social scientists operating in Mexico begin to question technoscientific intervention and its foundational premise, modernization theory.[15] The transition

[13] Margin, "Decolonization of the Mind," 24. Marglin insists culture is more than its set of largely tacit and unconscious rules and values — that cultures are likewise built of knowledge systems composed of epistemology, transmission, innovation, and power.
[14] Vandana Shiva, "Science and Politics in the Green Revolution," in *The Vandana Shiva Reader* (Lexington, KY: UP of Kentucky, 2015), 17.
[15] *Campesinx* is simply a gender neutral combination of campesino and campesina. For an introduction to this convention, see: Yesenia Varela, "The Use of the "X": An Effort to Make Spanish Inclusive," *The Spectator*, May 3, 2017, accessed April 8, 2018, http://www.seattlespectator.com/2017/05/03/use-x-effort-make-spanish-inclusive/

among Green Revolution social scientists from incredulity in the late 1960s to reformism in the early 1970s and eventually to outright condemnation in the late 1970s maps onto the Green Revolution's trajectory from modernization theory's exemplar to its undoer. The late twentieth and early twenty-first century proponents of epistemologies of the South latch onto historical antecedents like the Green Revolution in Mexico to make their case against contemporary development regimes.

For example, Shiva connects the violence of the Green Revolution to the very nature of a project that, "in its very genesis," was "put forward as a political project for creating a social order based on peace and stability."[16] She deploys the social construction of scientific knowledge to connect and subordinate the supposedly value-neutral technoscientific intervention package of the Green Revolution to the prerogatives of state-formation and the maintenance of socio-political order. For Shiva this connection represents an attempt at "social engineering." Modernization theory became imperiled when social engineering endeavors began to display the unintended consequences that technoscientific interventions inevitably entail, and also when, as their social construction is revealed, technology and science lose their immunity to these unintended consequences. Through the evolution of social-scientific evaluations of the Green Revolution in Mexico throughout the 1970s this thesis shows both the unintended consequences of the Green Revolution and the loss of technoscience's immunity to those consequences. Shiva, de Sousa Santos, Nunes, Meneses, Mingolo, and Marglin, then, can be grouped collectively as respondents to a crisis in modernization theory that began with the Green Revolution in Mexico. They are also proponents of a paradigmatic replacement: the restoration of subalternated epistemologies and the rejuvenation of the knowledge ecosystem (to expound on de

[16] Shiva, "Science and Politics in the Green Revolution," 16.

Sousa Santos's metaphor) via the reintroduction of displaced epistemic species, the curtailment of an invasive predator, and the homeostatic stabilization of a new hybrid *pluriversal* knowledge ecosystem.[17]

Methodology from the Sociology of Technoscientific Knowledge

This thesis reads the Green Revolution in Mexico as an historical precipitant of the crisis in modernization theory. Insofar as contemporary sociologists of knowledge view modernization theory as a threat to non-Northern knowledge systems, the Green Revolution's precipitation of a crisis in modernization theory ties historical investigations of the Green Revolution to contemporary explorations of epistemological alternatives. Tariq Banuri, one of Marglin's former advisees in Harvard's Department of Economics, takes the crisis in modernization theory as his point of departure in search of validation for non-Northern ways of knowing. For Banuri, the proposal of epistemologies of the South in response to the crisis "derives not from the discovery of some hitherto unobserved social costs [epistemic marginalization, ecosystemic degradation, accentuated socio-economic inequality]," but, as I have shown in the work of Shiva, de Sousa Santos, Nunes, Meneses, Mingolo, and Marglin, from a rearticulation of those costs functioning as "essentially an affirmation of earlier doubts."[18] I contend that the Green Revolution was one of the wellsprings of those

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[17] Eben Kirksey, ed., *The Multispecies Salon* (Durham: Duke UP, 2014).
Historiography as a genre is a subroutine of the Northern academic protocol heavily dependent on classification and taxonomy. I do not intend to be reductive about the variety and differences of Southern epistemologies that challenge the dominant technoscientific episteme by grouping them.
For a cosmology that deals with the *pluriverse*, rather than the Northern cosmology of the universe, see: Cesar Carrillo Trueba, *Pluriverso: Un Ensayo sobre el Conocimiento Indígena Contemporáneo* (Mexico City: UNAM Press, 2012. (Pluriverso: An Essay on Contemporary Indigenous Knowledge). Chambers and Gillespie add to this in their section "Bringing Disparate Knowledge Systems Together." Chambers and Gillespie, "Locality in the History of Science," 235-37.

[18] Tariq Banuri, "Development and the Politics of Knowledge: A Critical Interpretation of the Social Role of Modernization Theories in the Development of the Third World," in *Dominating*

earlier doubts and, moreover, that those doubts arose as a byproduct of the same social-scientific evaluations designed to refine and facilitate the Green Revolution development regime. Banuri believes it necessary to "examine in detail the intellectual and cultural roots" of critiques of modernization. Using the Green Revolution in Mexico as an exemplar, in this thesis I intend to locate some of the intellectual and cultural roots of critiques of modernization in 1970s anthropology of development.

To that end, I show that the Green Revolution in Mexico was not a pure implementation of technoscience enshrined in neutrality and set apart from sociocultural concerns. Instead the Green Revolution development regime in Mexico was an inextricable interplay of its technoscientific intervention and a social-scientific intervention with which it was co-productive. I employ the concept of co-production set forth by Sheila Jasanoff, a sociologist of science and technology, in her seminal 2004 volume *States of Knowledge: The Co-production of Science and Social Order*. Jasanoff developed the concept of co-production to facilitate conversations between STS and its disciplinary neighbors about the links between knowledge, culture, and power and to describe the feedback effects of the ways in which knowledge reconfigures social and political structures and how those reconfigurations subsequently alter the very terms in which we think about the world.[19] For Jasanoff, co-production is an idiom to be used to describe complex entanglements between technoscientific and sociopolitical/institutional phenomena.

Various dialects of that idiom, if not the term "co-production" itself, are inscribed in the aforementioned works of the sociology of knowledges. Marglin uses the mutually reinforcing nexus of liberal democratic government, rationalized bureaucracy,

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Knowledge: Development, Culture, and Resistance, eds. Frederique Apffel Marglin and Stephen Marglin (Oxford: Oxford UP, 1990).

[19] Sheila Jasanoff, "The Idiom of Co-production," in *States of Knowledge: The Co-production of Science and Social Order* (New York: Routledge, 2004), 2.

technoscientific industry and agriculture, and global commercial capitalism to describe both modernization theory and the process of interventionist modernization.[20] Shiva not only describes the Green Revolution as a "political project for creating a social order," as shown above, but states that the knowledge-power nexus is the essence of reductionism because mechanistic thought "was associated with a set of values based on power that was compatible with the needs of commercial capitalism" which "generates . . . domination."[21] Shiva also alludes to the co-productive relationship between science and state when she argues that Green Revolution technology "involved a restructuring of the way power was distributed in society" that "defined new links between the state and cultivators, between international interests and local communities . . .."[22] The idiom of co-production is also legible when de Sousa Santos, et al. locate the foundation stone of the "capitalist and imperial order that the global North has been imposing on the global South" in the "epistemological privilege" of modern science "which made possible the technological revolutions that consolidated Western supremacy."[23] Those supremacy-consolidating technological revolutions simultaneously accentuated the epistemological privilege of modern science. Even when they are not using the term "co-production," these sociologists of knowledge are employing the idiom of co-production.

In this thesis, the idiom of co-production is used primarily and most substantially to detail the complex interdependency of technoscientific and social-scientific work in the Green Revolution. To arbitrarily point to the "beginning" of a loop: the impetus for technological interventions in general and the Green Revolution in particular was the social scientific conception of a (Southern) "archaic" essential

[20] Marglin, "Decolonization of the Mind," 2.
[21] Shiva, "Science and Politics in the Green Revolution," 17.
[22] Shiva, "Science and Politics in the Green Revolution," 31-32.
[23] De Sousa Santos, "Opening up the Canon of Knowledge," xix.

"peasantness" and a (Northern) "modern" self-interested economic rationale. The belief that modernization and the mentality of modernity could be tactically engendered in a target population was derived from progressive-era beliefs in social engineering that privileged social scientific modes of analysis. On the wave of social-scientifically buttressed theories of modernization, development, and technological diffusion, American plant geneticists, soil scientists, entomologists, and other agronomists set to work implementing an agronomic intervention in Mexico. They developed technologies locally, imported technologies from the United States, and assembled these technologies into deployment packages. After deployment, various social scientists visited the zones of implementation, studying farmers and communities, and produced econometric algorithms and ethnographies to model Mexican farmers' receptiveness to these technoscientific packages. The results of this social-scientific labor were then fed back to development planners and agronomic managers so that the technoscientific packages could be refined and redeployed. The bulk of this thesis's primary source analysis works to trace this loop using ethnographic and econometric studies by scholars from both within the Rockefeller Foundation and outside it (though often still funded by it) between 1965 and 1979.

I have stated my argument that technoscientific and social-scientific interventions co-produced one another to form the Green Revolution development regime, but, as one might glean from the subtitle of *States of Knowledge*, with what statist components was that development regime co-productive?[24] According to its planners, scientific triumphalists, and the Nobel committee that awarded Norman Borlaug, the Green Revolution wheat breeder, the Nobel Peace Prize in 1970, the Green

[24] Not all syntactical elements of this new "idiom" of co-production are yet standardized. It is worth noting that once you believe you are beginning to understand the structural properties of co-productivity, you begin to realize how difficult it is to apply prepositions to.

Revolution aimed to thwart a post-World War II population boom-induced Malthusian cataclysm and save innumerable Third World masses from starvation or malnourishment; the U.S., Mexican, and Rockefeller planners and agronomists probably believed this to an extent.[25] However, this thesis, more suggestively than substantively, proposes a set of embedded hierarchical co-productive relationships in which the co-produced development regime of the Green Revolution was nested. One level up from the Green Revolution at the national scale, for the Mexican federal government under Ávila Camacho (1940-1946), the Green Revolution was co-productive with the Mexican strategy to industrialize and urbanize its economy and with the Mexican policy of *indigenismo*. *Indigenismo* was an integrationist policy to incorporate Mexico's indigenous population, along with its European and culturally-European *mestizo* population, into a new singularly Mexican national identity. Economic industrialization, urbanization, and cultural integration were subcomponents of Mexico's modernization strategy. Another level up, at the international scale, the co-produced modernization of Mexico was also co-productive with American Cold War pseudo-territorialization — the attempt to carve out a sphere of liberal democratic and capitalist influence as a bastion against Soviet expansionism.[26]

Historical Background and Analysis of Green Revolution Stakeholders

The Co-production of the Green Revolution and American Cold War Objectives: Pseudo-territorialization of a Liberal-Democratic Capitalist Sphere of Influence

[25] Bernard Weinraur, "US Agronomist gets Nobel Peace Prize," *New York Times*, October 22, 1970, https://www.nytimes.com/1970/10/22/archives/us-agronomist-gets-nobel-peace-prize-1970-nobel-peace-prize-won-by.html

[26] Joseph Cotter, *Troubled Harvest:Agronomy and Revolution in Mexico, 1880-2002* (Westport, CT: Praeger, 2003), 263.

From the perspective of the United States, the Green Revolution is best understood by its Cold War orientation. Although the Green Revolution in Mexico officially began in 1943, President Truman's 1949 inaugural address demonstrates the relationship between American Cold War pseudo-territorialization and international development programs like the Green Revolution. The speech was designed to counter the "false philosophy of communism" in four points. After reaffirming U.S. support for the United Nations, the global post-war economic recovery, and the promise to "strengthen freedom-loving nations against the dangers of aggression" in the first three points, the fourth point reads: "we must embark on a bold new program for making the benefits of our scientific advances and industrial progress available for the improvement and growth of underdeveloped areas."[27] In some ways this was related to the dual Malthusian spectre of overpopulation and food insecurity used to propagandize the Green Revolution. Policy planners, politicians, and economists believed that food shortages would radicalize Southern subsistence farmers and drive them into Stalin's (or soon Mao's) waiting arms. Contrarily, exporting American agricultural implements and scientists would lead to scientific, technological, and economic "modernization," which would in turn lead to democratization and the stability of an international capitalist market.[28] Drawing the through line between industrial development and democracy even more confidently, W. Arthur Lewis, the St. Lucian recipient of the 1979 Nobel Memorial Prize in Economics for his work on

[27] Harry S. Truman, "Truman's Inaugural Address," Harry S. Truman Presidential Library and Museum, https://www.trumanlibrary.org/whistlestop/50yr_archive/inagural20jan1949.htm
[28] Howard P. Segal, "Progress and Its Discontents: Postwar Science and Technology Policy," in *The Social Sciences Go to Washington: The Politics of Knowledge in the Postmodern Age*, ed. Hamilton Cravens (New Brunswick, NJ: Rutgers UP, 2004), 112-113.
Audra J. Wolfe, *Competing with the Soviets: Science, Technology, and the State in Cold War America* (Baltimore: Johns Hopkins UP, 2013), 55-56.

growth, wrote: "The case for economic growth is that it gives man more control over his environment, and thereby increases his freedom."[29]

These "unscientific" premises for intervention, according to Howard P. Segal, were "papered over" with "self-consciously scientific" models full of statistics and graphs, subordinating social-scientific modeling to modernization theory's neoliberal philosophical tenets. But Segal does not discuss how the econometric and sociological models and theoretical premises of technological intervention actually produced one another.[30] This thesis takes a step in that direction. Regardless of its feasibility, the cachet of modernization theory demonstrates the contemporaneous awareness of the relationship between Cold War geopolitical goals and the expansion of Northern technoscience, clearly conveyed in Truman's inauguration speech. Two of the most prominent exponents of modernization theory, Talcott Parsons and Edward Shils, hypothesized that human attitudes could be devised as combinations of dichotomies they called "pattern variables" — another model — used to arrange societies on a continuum from "traditional" to "modern."[31] The use of such dichotomies as both behavioral assumptions and building blocks of behavioral models will surface repeatedly in this thesis and was representative of Northern mechanistic attitudes to understanding nature and, as often, was antithetical to alternative Southern epistemologies.

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[29] W. Arthur Lewis, *The Theory of Economic Growth* (London: George Allen and Unwin, 1955), 421. Quoted from Marglin, "Decolonization of the Mind," 11.

Regrettably absent from this thesis is the role played by institutions of capital and multinational corporations in the socio-technical intervention of Mexico in the Cold War. Marx, Marxists and other scholars of Taylorism and the regimentation of labor have well established the role of regimentation in the capitalist control of production and laborers, for example: Harry Braverman, "Technology and Capitalist Control," in *The Social Shaping of Technology, 2nd Ed.*, eds. Donald MacKenzie and Judy Wajcman (Philadelphia: Open University Press, 1999), 158-160.

[30] Segal, "Progress and Its Discontents," 113.

[31] Wolfe, *Competing with the Soviets*, 60.

Although modernization theory served well to encourage the promotion of economic growth through the technoscientific industrial development of the South, it did not initially provide a theoretical basis for connecting the goals of economic and technoscientific development to geopolitical strategy. John Perkins, in his *Geopolitics and the Green Revolution* echoed this sentiment in his attempt to make clear just such a relationship: "Aside from imperialism, therefore, in 1939 no analytical framework existed to see how agricultural science and technology and modernization of agriculture fit into the overall scheme of international relations and power."[32] The Cold War, of course, had yet to flare up during modernization theory's infancy, but the rise of the Soviet "menace" made possible the conflation of food instability, political radicalization, and the fear of Soviet expansionism. By 1949, Truman, on the basis of this conflation, was able to justify a geopolitically-strategic technoscientific intervention on a supposedly non-imperialistic theoretical foundation, completing the coupling of modernization theory, and by association agricultural development in Mexico, to Cold War pseudo-territorialization.[33]

The Co-Production of the Green Revolution and Mexican Cold War Objectives: National Identity Formation and Modernization

One of the "underdeveloped areas" Truman was silently alluding to in his four point plan was Mexico. Although plans for an agricultural intervention in Mexico date loosely back to the 1930s, they began in earnest in 1941 when the Rockefeller foundation sent a survey team to conduct a feasibility study. Just prior to that, the U.S.

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[32] John Perkins, *Geopolitics and the Green Revolution* (Oxford: Oxford UP, 1997), 103. Perkins's book is an invaluable resource for understanding the relationship between the Green Revolution and the expansion of American influence during the Cold War, but it approaches its themes from the perspective of political ecology and not the history of science or technology.

[33] For a discussion of the newly-found 20th century ability of science to "become an authority to legitimate public action," and for a general overview of the relationship between science, political, power, and the state, see: Dominique Pestre, "Science, Political Power, and the State," in *Companion to Science in the Twentieth Century*, eds. John Krige and Dominique Pestre (New York: Routledge, 2003), 61-76.

sent Henry Wallace, then Vice President under Roosevelt, former Secretary of Agriculture, and strong proponent of 1930s progressivism *a la* American governmental development-oriented intervention during the Great Depression, to Mexico as the U.S. ambassador to Ávila Camacho's December, 1940 inauguration. Part of Camacho's modernization plan for Mexico included the policy of *indigenismo*. The politics of *indigenismo* policy, and national ethno-identity formation in general, in Mexico are convoluted and, in any great detail, beyond the scope of this study, but Camacho, through primary and secondary school curricular reforms and other nationalism-generating standard fare, continued the *indigenismo* policy of his predecessor Lázaro Cárdenas. Cárdenas was, in his own words, "not concerned with keeping the Indians as Indians, or with indianizing Mexico, but rather with mexicanizing the Indians."[34] One component of Mexico's modernization, then, required the homogenization of its culturally-disparate demographic subgroups into a singular Mexican national identity adopting the Northern attitudes to industrialism and secularism of its European and mestizo populations.

Camacho differed from Cárdenas when it came to economic policy, however. Cárdenas was a campesinx-oriented socialist intent on fulfilling the goals of the 1910 Mexican Revolution. He redistributed more hacienda land to small-holder farmers and *ejidatarios* than any other president since agrarian reform became the defining promise of the 1910 revolution. Camacho, alternatively, was concerned with the modernization of Mexico's agricultural and industrial sectors and the urbanization that would entail. The Green Revolution serviced all of these policy aims. Camacho's vision for an urbanized technologically-driven Mexican economy can be described by what Carol E. Harrison and Ann Johnson call a "national imaginary." In their introduction to

[34] Larissa Lomnitz, "Anthropology and Development in Latin America," *Human Organization* 38, no. 3 (Fall 1979), 314.

National Identity: The Role of Science and Technology, Harrison and Johnson argue that nations use scientific prowess to perform their modernity, both to other nations and to their citizens whom they hope to enlist in that national imaginary.[35] Insofar as technoscientific prowess exists in a generative relationship with a national imaginary, we can talk about Jasanoffian "sociotechnical imaginaries." It is not a contention of this thesis, but a difficult-to-set-aside implicit assumption underneath the analytical work of this thesis, that the co-production of the Green Revolution and American Cold War pseudo-territorialization, or of the Green Revolution and Mexican modern national identity, function as sociotechnical imaginaries to the extent that these undertakings were mythologized as wars against world hunger, the spread of the "disease of communism," or the glorification of Mexico vis-a-vis its place in Latin America and the world.

The Green Revolution Itself

As for the technoscientific intervention of the Green Revolution, after the initial survey expedition in 1941, the Rockefeller Foundation, in conjunction with the Mexican federal government, initiated the Mexican Agricultural Program (MAP) and formed the Office of Special Studies to build research stations in 1943. The Rockefeller Foundation deployed plant geneticists, soil scientists, entomologists, and plant pathologists to the

[35] Carol E. Harrison and Ann Johnson, "Introduction: Science and National Identity," *Osiris: National Identity: The Role of Science and Technology*, Vol. 24, eds. Carol E. Harrison and Ann Johnson (2009), 1-14. Harrison and Johnson, and the many authors contributing to this edited volume, locate national identity "in the conjunction of modern professional science, state sponsorship, and an engaged citizenry" (p. 3). Suzanne Moon's study set in Indonesia, "Justice, Geography, and Steel: Technology and National Identity in Indonesian Industrialization is a characteristic example with informative applicability to the Mexican case. Where Suharto sought to unify the geographically and ethnolinguistically dispersed new Indonesia with a steel plant in West Java, the Mexican government under Ávila Camacho sought unification through agricultural technoscientification and the urbanization it would induce. Harrison and Johnson do not, however, describe this conjunction as the site of a complex co-productive relationship, as I attempt to in this thesis. The case studies in the edited volume cover much ground, but their examples "drawn from a variety of Eastern and Western nation-states" very much stick that longitudinal arrangement — the only cases outside of Europe and settler-colonized North America are set in India, China, and Indonesia — and none from Latin America. Mexico, if studied from their perspective should be added as a case study.

Office of Special Studies to develop hybrid wheat and maize seeds (HYVs, high-yielding varieties) adapted to conditions in Mexico's central highlands east of Mexico City at the agricultural college at Chapingo.[36] In 1966, control was officially handed over from the Rockefeller Foundation to the Mexican Ministry of Agriculture, although the Rockefeller agents remained in all their capacities, resulting in the termination of the Office of Special Studies and its transformation into the International Maize and Wheat Improvement Center (*sp.* acronym, CIMMYT), a global institution that coordinated the deployment of the Mexican agricultural industrialization model to India, Pakistan, the Philippines, North Africa, and Colombia, among other places. At the same time, initial shortcomings in the Green Revolution deployment in Mexico were becoming evident. Yield increases from HYV wheat development, optimized for mechanized irrigation and ultra-high doses of synthetic fertilizer, far outpaced maize HYV development. This privileged wealthy wheat farmers with large holdings in northwestern Mexico and drastically accentuated socio-economic stratification between these industrial farmers and the campesinx small-holder farmers and *ejidatarios* who subsisted off of maize and made up the vast majority of Mexican farmers.[37] This "shortcoming" led to the creation of *Plan Puebla* in 1967, an attempt to replicate the gains made in wheat HYV development, but refocused for rainfed, often subsistence-level maize farmers. In 1970, Borlaug, who worked on the wheat program, was awarded the Nobel Peace Prize, yet Plan Puebla quickly proved inefficacious; the attempt to breed high yielding-varieties of maize adapted to the numerous climatic and biological zones of Mexico was abandoned, and efforts were redirected toward the creation of input recommendations

[36] For a discussion, instead of social scientific reactions to the Green Revolution in Mexico, of the reactions of Mexican agronomy students at the National School of Agriculture at Chapingo during the student uprisings in 1967, see: Matthew Caire-Perez, "A Different Shade of Green : Efraím Hernández, Chapingo, and Mexico's Green Revolution, 1950-1967" (Ph.D. diss., University of Oklahoma, 2016).
[37] Cotter, *Troubled Harvest*, 263.

(of fertilizers, biocides, water, and planting densities and schedules) for different bio- and climate regions of Mexican maize growing. Beginning in the early 1970s, and with finality by 1979, the end of this study period, the deleterious ecological, cultural, and socio-economic consequences of the Green Revolution had become difficult to ignore. Still, work in agricultural industrialization and systematization through international intervention continues in Mexico and everywhere in various forms and to varying degrees.[38]

The Anthropological Debate on Essential "Peasantness"

Attempts to explicate an essentializing and homogenous "peasantness" undergirded anthropological, sociological, and econometric field work in Mexico. Anthropologists were especially eager to enter into debates about the inherent and "natural" conservatism of "the peasant". Generating a dichotomy of peasant mentalities, anthropologists debated whether cultural or material factors predominated in peasant choice-making, with one cohort of anthropologists asserting that cultural factors enforced adherence to tradition (and thus rendered the campesinx inherently conservative), while an opposing cohort of anthropologists insisted that campesinxs were amenable to financial incentives and status enhancements through the acquisition of personal property and were thus inherently innovative.

This debate came to a head in *American Anthropologist* between 1972 and 1976 in a flurry of line-in-the-sand-drawing assertions and consequent retorts. This eruption is somewhat surprising because Frank C. Miller, just 7 years prior, found no reason for

[38] Focusing on the post-Cold War United States in which many, including Jasanoff, see a "runaway ambition to impose military dominance, ideological conformity, and cultural homogeneity on the rest of the world," Sheila Jasnoff provides another chapter in the Green Revolution saga by looking at what some are calling a "Second Green Revolution" in which genetic engineering, gene splicing, and cell fusion are used to create new synthetic cultivars to be deployed through new neo-colonial (if such a term can be written) technoscientific interventions. Sheila Jasanoff, "Biotechology and Empire: The Global Power of Seeds and Science," *Osiris: Global Power Knowledge: Science and Technology in International Affairs* Vol. 21, eds. John Krige and Kai-Henrik Barth (2006), 273-292.

anthropologists to participate in these polarizing debates in his "Cultural Change as Decision-Making: A Tzotzil Example," where he studied the acceptance and use of a medical outpost by a Tzetal community in highland Chiapas.After conducting extensive ethnographic work in the community Miller concluded definitively that "[t]he extent to which such choices are ultimately determined by cultural or material factors is an issue that is not empirically resoluble at the present time. . . . I maintain only that both affirmation and denial are metaphysical stances, neither of which can be proved by anthropology."[39] Despite Miller's warning, between 1972 and 1978 several anthropologists nonetheless debated the essential mental qualities of "peasanthood."

In hindsight, from the vantage point of 1978, Clawson was able to summarize this debate and reformulate its dichotomies into a workable hybrid methodological approach for his 1979 study of the Puebla community of Nealtican. Clawson first strengthens the dichotomy by condensing its positions in sections entitled "Peasants Are Poor Innovators" and "Peasants Are Good Innovators." Of those who insisted peasants were poor innovators, Clawson included Charles Erasmus's *Man Takes Control* (1961), Oscar Lewis's *Life in a Mexican Village: Tepoztlán Restudied* (1951), H. Ian Hogbin's *Social Change* (1958), and George Foster's "Peasant Society and the Image of the Limited Good" (1965) and *Applied Anthropology* (1969). George Foster's concept of the "Image of the Limited Good" asserted that for peasant societies there exists a finite amount of zero-sum "good" and consequently, "innovative people tend to be seen as rapacious and greedy. Because they are upsetting the traditional distribution of 'good,' of the limited resources of the group, they are viewed as threats to community stability rather than as entrepreneurial models to be emulated."[40] This claim, without

[39] Frank C. Miller, "Cultural Change as Decision-Making: A Tzotzil Example," *Ethnology* 4, No. 1 (Jan. 1965), 54.
[40] George Foster, *Applied Anthropology* (Boston: Little, Brown, 1969), 83.

caveats to certain places, ethno-linguistic groups, or times, would become the focus of rebuttals.

Punning off of Foster, James Acheson rejected his view with "Limited Good or Limited Goods? Response to Economic Opportunity in a Tarascan Pueblo" in 1972. Rather than a cognitive inhibition to innovation, Acheson argued that it was, instead, a lack of access to credit, favorable markets, capital, and the risk-security they provided that prevented peasants from engaging in entrepreneurial activity. Acheson drew a direct contrast with Foster by paraphrasing Foster's description in *Tzintzuntzan: Mexican Peasants in a Changing World* (1967) of how innovation was stifled by interpersonal relationships in Tarascan communities because they were "marked by suspicion, vindictiveness, spite, envy, malicious gossip, and lack of cooperation."[41] Although Acheson may have taken liberties with that provocative litany of descriptors,, he was careful to use Foster's own words to substantiate the sentiment he opposed: "[a] large part of this inability and reluctance to change is due, as we have seen, to personality and social factors: village culture and society, reflecting a cognitive orientation that views all good things in life as finite . . .."[42] Acheson's countervailing view, which he expected to be revealed through his research was that some Tarascan farmers *are* motivated by economic incentives, and concluded that "[t]he presence of superior economic opportunities is the single most important factor involved in developmental change."[43] Acheson also emphasized that indigenous Mexican smallholder farmers *could* innovate without the intervention of an external agency. It is important to note, however, that the entrepreneurial attitude Acheson identified in

[41] James M. Acheson, "Limited Good or Limited Goods? Response to Economic Opportunity in a Tarascan Pueblo," *American Anthropologist* 74, no. 5 (Oct. 1972), 1152.
[42] George M. Foster, *Tzintzuntzan: Mexican Peasants in a Changing World* (Boston: Little, Brown, 1967), 250. Quoted in Acheson, 1152-53.
[43] Acheson, 1161.

some of the subjects of his ethnography did not prevent him from considering much of the Tarascan community to be stymied by "cognitive factors," and while he affirmed the presence of the unquestioned virtue of profit-maximizing behavior in some members of the Tarascan community of Tzintzuntzan, he simultaneously affirmed areductive dichotomy for understanding the peasant mentality by envisioning his subject community in terms of those for whom the economic opportunities available overrode the cultural barriers, and those for whom they did not.

In true Hegelian dialectic form, it seems, Foster's thesis and Acheson's antithesis necessitated a synthesis, and it was supplied by John Kunkel in his 1976 "Opportunity, Economics, and Behavior: A Comment on Acheson and Foster." Kunkel put the dichotomous formulation of economic and cultural factors in decision-making present in Acheson's and Foster's work under scrutiny, and aptly characterized it as "more of an academic artifact than a reflection of village life, [one that] unduly obscures their mutual influences."[44] Kunkel instead offered a view of decision-making as a moment-contingent interplay of the diachronic consequences of an idiosyncratic individual's calculations, imaginings, and assumptions. These consequences could take material form — as the proponents of peasant innovativeness assumed predominated in any "rational" person— but they could also be symbolic, affect interpersonal relations, or be intrinsic or extrinsic.[45] Kunkel also criticized attempts to model the peasant mentality not only for their binaries and reductivity, but for their failure to distinguish between *etic* and *emic* understandings of behavior. Put simply, the emic views are decision-makers' own understandings of their decision-making priorities and process, while the etic view is an outside observer's understanding of another's

[44] John H. Kunkel, "Opportunity, Economics, and Behavior: A Comment on Acheson and Foster," *American Anthropologist* 78, no. 2 (Jun. 1976), 327.
[45] Kunkel, "Opportunity, Economics, and Behavior," 328.

decision-making priorities and process. Failure to be mindful of this disconnect deceives observers into believing the subjects of their observations act on the values that the observer assigns them. Kunkel implied Acheson and Foster were guilty of this category mistake in their respective assumptions of an economically "rational" peasant responsive to external stimuli (in our case by Northern development agents) and an intrinsically obstinate tradition-bound peasant.[46] It might be noted that ethnographic methodology at this time was prone to tripping the *emic-etic* booby trap by establishing an etic approach in the hypothesis of the project, in which the ethnographer brought assumptions about the community into the study.

Kunkel's insinuation that Acheson and Foster were failing to perform basic ethnographic quality control was answered by Acheson in a reply to Kunkel's accusations in the same issue of *American Anthropologist*. Whereas Kunkel emphasized the mutual influence of material and socio-cultural factors, Acheson here provided a reason for their compartmentalization: namely, that material factors are readily quantifiable while socio-cultural factors are only quantifiable with great difficulty, if at all. Though Acheson admitted to the econometrician's propensity to assume that material rewards are all that matter, that "man is nothing as much as bribeable," he justified this heuristic by the effectiveness of the tools econometricians can develop when they ignore those difficult to quantify socio-cultural factors.[47] This is best exemplified when Acheson points out that "[w]hen econometricians are modeling economic and social variables together, it is no accident that the social variables are

[46] For a more thorough look at Kunkel's study of behavioral modeling see: John H. Kunkel, "Economic Autonomy and Social Change in Mexican Villages," *Economic Development and Cultural Change* 10, no. 1 (Oct. 1961), 51-63; and John H. Kunkel, "Some Behavioral Aspects of the Ecological Approach to Social Organization," *American Journal of Sociology* 73, no. 1 (Jul. 1967), 12-29.
[47] James M. Acheson, "New Directions in Economic Anthropology? A Comment on Kunkel," *American Anthropologist* 78, no. 2 (Jun. 1976), 333.

usually expressed as constants in the equation."[48]This statement is an excellent formulation of the state of development-oriented economics, sociology, and anthropology in the period.

What was at stake in these anthropological debates over peasants, as an academic-artificial global superclass was the validity of econometricians devising algorithmic models of peasant behavior in order to more effectively alter the institutional framework of the communities to which the transfer of Northern technoscientific objects and ideas was believed to be necessary. In these econometric algorithms, those factors held in highest esteem in the Northern priority scheme — material and financial factors — were most readily instantiated in behavior models as variables, facilitating the optimization of the algorithms. On the other hand,socio-cultural factors — symbolism, nonmaterial sources of status, and interpersonal relationships — were non-optimizable, and could only be registered as estimated constants in the algorithm. In the end, according to Acheson, these factors could be ignored because the econometric model worked well as a heuristic without them.

Kunkel incisively identified the methodological underpinning of this algorithmic workflow as the quest for the fabled *Homo economicus*. This "economic man," best represented for our purposes by Acheson's model of "Limited Goods," was an attempt to develop an econometric protocol to model, predict, and influence microeconomic decision-making predicated on the assumption that individuals will act so as to maximize their financial status, and that their decisions were thus reducible to cost-benefit analyses.[49] This attempt to produced totalizing models of decision-making

[48] Acheson, "New Directions in Economic Anthropology?", 334.
[49] Kunkel, 327. It was, in fact, one of only several so called "models of man." Kunkel himself studied various man-model making approaches and outlined them in John H. Kunkel and Richard H. Nagasawa, "A Behavioral Model of Man: Propositions and Implications," *American Sociological Review* 38, no. 5 (Oct. 1973), 530-543.

for prediction and control demands special scrutiny in the context of a neo-colonialist enterprise such as the Green Revolution in Mexico because such models were devised in a Northern liberal-democratic context in which, in theory, microeconomic decisions arise from voluntary transactional or contractual arrangements between buyers and sellers or producers and consumers. In a neo-colonial context, models of "man" are not used to merely reflect and understand voluntary arrangements but to make and perpetuate involuntary ones.

Some of the related questions I touch upon in the following chapters, or from which the following chapters touch off are: How were models of man developed and optimized on American consumers and laborers adapted to Mexican small-holder farmers? What were the social-scientific justifications for generalizing across Northern consumers, global Southern peasants (conceived of as a homogenous entity), and Mexican small-holder farmers to create a universal model of "man"? What does this presumed universality of model-making reveal about social-scientific conceptions of human nature and pan-human homogeneity in the 1970s? If the universality of totalizing models of "man" were assumed and imposed, as *Homo economicus* was presumed to be the sole demographic of the capitalist world, to what extent did the attempt to sculpt "the peasant" into a model rational-economic actor contribute to the inculcation of indigenous agriculturalists into Northern capitalist agriculture and Mexican nationalist identity? What is the relationship between these models of man and the MAP, CIMMYT, and Plan Puebla agro-development projects in Mexico between 1943 and 1979? Were the models of man recalibrated in light of the Mexican case? Were agro-development projects, ostensibly only designed to increase food stability and food independence in Mexico, used as test cases for refining models of economic command and control? How does the *model-predict-control* social-scientific workflow reflect Northern presuppositions about how knowledge is generated and

operationalized? Does the case of the Green Revolution in Mexico — in both its technoscientific agricultural implementation and social-scientific analysis and refinement — represent an attempt to radically reformulate Mexican indigenous and *campesinx* epistemic principles and institutions in the image of the Northern model?

These questions both helped produce this thesis and often arise out of its claims and evidentiary documents, but answering all of them, or any of them with any degree of comprehensiveness, is not the chief aim of this thesis. Instead, this thesis hopes to demonstrate the need for preparatory exploration to clarify the operating assumptions of Northern techno- and social scientific interventions in the South. This thesis, however hints at the scholarly possibilities of such questions for anti- and post-colonial history, and insists to other historians, especially in science and technology studies, that an essential starting point is recognizing the tripartite co-production of (1) the Northern episteme (the scientific method, for the sake of brevity); (2) power-asymmetric governmental, para-governmental, and multinational corporate interventionism in the South by the North; and (3) a new liberal-democratic industrial-capitalist Mexican nationalism.[50]

Before we can begin to explore the ramifications of these questions in social-scientific case/field studies of agricultural development in Mexico, we must first assess the literature between 1956 and 1973 on agro-development that incentivized and legitimized social science field studies. This undergirding agro-development literature discussed the prospects and pitfalls of the Green Revolution's deployment in Mexico, or, with a wider focus, theorized a framework for "diffusion studies," the scientific approach to facilitating technology transfers anywhere. The Rockefeller endeavor in Mexico was in this light construed as laboratory in which theories of diffusion studies

[50] These three components, along with a set of ideological presuppositions about race, gender, religion, and sexuality, might be considered a working definition of a generic colonial regime.

become operative. Underneath these diffusion studies was the Northern-centric assumption that technoscientific fluency and production capacity was synonymous with cultural sophistication and superiority. The transfer of technology from the United States to Mexico, from this perspective, becomes a civilizing mission — another white man's burden — placing it more firmly in the analytic framework of anti- and post-colonial studies.[51]

Interpretations of the Green Revolution in Mexico: Economics and Diffusion Theory

One such commentary on technological diffusion with an eye on Mexico was Arthur T. Mosher's "A Review and Criticism of United States Participation in Agricultural Programs of Technical Cooperation," written in 1956 while he was employed at the Agricultural Development Council (then called The Council on Economic and Cultural Affairs, Inc.), an auxiliary institution to the Rockefeller Foundation founded by John D. Rockefeller III in 1954. Once a Presbyterian missionary to India in the 1930s, Mosher was trained as an agricultural economist before working for the Agricultural Development Council; a year after publishing this "Review and Criticism," he was appointed to its executive directorship. In this article, Mosher reflected prevalent attitudes concerning Southern small-holder farmer traditionalism or "choice-making" described above. First, Mosher established his argument on the fundamental assumption, informed by the work of Charles Erasmus and George Foster, that:

> [an] important characteristic of the cultures of most underdeveloped regions is the fact that their agricultural economies are traditional rather than choice-making. The prevailing pattern is for each new generation to be initiated to the care of traditional crops, in traditional ways, with traditional tools and implements. People are not encouraged to weigh alternatives and to make

[51] For more on the relationship between technology, dominance, and conceptions of "civilization," see: Michael Adas, *Machines as the Measure of Men: Science, Technologies, and Ideologies of Western Dominance* (Ithaca, NY: Cornell UP, 1989).

> choices, yet it is these processes of weighing alternatives and making choices that are central to agricultural development.[52]

Mosher went on to call the "widespread attitude in agriculturally underdeveloped countries" of seeking the benefits of new agricultural technology without having to relinquish traditional beliefs as "untenable" and declared that "important *noneconomic* aspects of each regional culture must change, both as a result of the specific new techniques introduced and as a precondition of more rapid agricultural development (emphasis mine)."[53] Coming from an executive of a Rockefeller-funded para-governmental entity with significant influence over the process of economic agro-development, this statement demonstrates the presumed inextricability of technological transfer and sociocultural intervention. The technoscientific package of synthetic inputs, engineered seeds, and electromechanized planting, harvesting, and irrigation was to be bundled with a sociocultural package of institutional overhaul and reeducation in the practice of Northern technoscientific research, development, deployment, and extension-based education, amounting to, in Mosher's words, a "cultural and psychological revolution."

Mosher here also hinted at the co-production of these two bundled packages: the new techniques were to precipitate sociocultural changes, and this changed sociocultural milieu — remade to be receptive to Northern technoscience would facilitate more rapid agricultural development. As John Perkins would put it when explaining the then nascent field of political ecology, "both the modifications of the biosphere and the political economic structures have a history that affects subsequent efforts to change either the technology or the social structure of agriculture."[54] Mosher's

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[52] A. T. Mosher, "A Review and Criticism of United States Participation in Agricultural Programs of Technical Cooperation, *Journal of Farm Economics* 38, no. 5 (Dec. 1956), 1198.
[53] Mosher, "A Review and Criticism," 1199.
[54] Perkins, *Geo-politics and the Green Revolution*, 7-8.

insistence on the inextricability of agricultural intervention and sociopolitical intervention, though by no means made within the intellectual framework of political ecology, was an episode of that "history" Perkins referred to. By insisting that a sociocultural intervention was necessary for a successful technoscientific intervention, development planners like Mosher provided the justification needed to expand the mandate of development aid from food security to institutional adjustment for Cold War geopolitical strategy.

While Mosher was, as an employee, interested in the application of diffusion theory to Rockefeller-supported endeavors, such scholars as the sociologists Elihu Katz, Martin Levin, and Herbert Hamilton gave an overview of diffusion studies with only passing reference to examples of agricultural diffusion in 1963. Katz, *et al.*, provided a general model of diffusion in seven parts as "the (1) acceptance, (2) over time, (3) of some specific item — an idea or practice, (4) by individuals, groups or other adopting units, linked to (5) specific channels of communication, (6) to a social structure, and (7) to a given system of values, or culture."[55] Although not as particularly interested as the Rockefeller-employed Mosher, Katz, *et al.,* were by no means disinterested observers of the process of diffusion: they actively promoted it and their article sought to generalize approaches to quantify it. They considered the time element of crucial importance, necessary for identifying early-adopting individuals and their characteristics, for charting diffusion curves. Such curves facilitated the construction of mathematical models of diffusion, lauded by Katz, *et al.*, and which they used to foreshadow and fertilize later field studies by suggesting that, "for example, one can construct theoretical models of the diffusion process given certain assumptions and compare the results with those actually observed in the real world. On the basis of such a

[55] Elihu Katz, Martin Levin and Herbert Hamilton, "Traditions of Research on the Diffusion of Innovation," American Sociological Review 28, no. 2 (April 1963), 237.

comparison, one can infer whether a given item is 'contagious' or not . . .."[56] Besides the time factor, the entire seven-part diffusion process Katz, *et al.*, outlined above represented a mechanistic approach to cultural change, one derived from the Northern epistemic mode. This approach prioritizes atomistic problem solving and the belief that complex organic phenomena can be understood quantitatively as sums of discrete subcomponents, rather than as contingent hybridities of elaborate interdependencies subject to chaotic combinatorics, as we now understand ecosystems.[57] Echoes of Katz's mechanistic attitude to cultural change and technological diffusion, and even of his seven-part process model, are evident in the field studies of Jones, Benito, Moscardi, and De Janvry between 1973 and 1977. Katz, *et al.*'s model casts the dynamics of technological diffusion as a "science," with lawful regularities and manipulable variables: a set of causal claims about how technological and industrial artifacts, techniques, and mentalities could be purposely engendered in a target population. Put simply, because of the co-production of technoscience and state power, I treat diffusion studies as the science of neo-coloniality.

As with Mosher, E. Walter Coward and Wayne A. Schutjer, an agricultural economist at Pennsylvania State University and the Director of the Research and Training Network at the Agricultural Development Council, also alluded to the co-production of technoscientific and socio-cultural components of development. They recognized that "a change in either technology or organization will create tension for subsequent adjustment in the other" in their 1970 overview "The Green Revolution: Initiating and Sustaining Change."[58] Coward and Schutjer extended this theoretical

[56] Katz, et al., "Traditions of Research," 242-3.
[57] What might be, and have been, more pithily but utterly opaquely called "wicked problems": cf. C. West Churchman, "Wicked Problems," *Management Science* 14, no. 4 (Dec. 1967).
[58] E. Walter Coward and Wayne A. Schutjer, "The Green Revolution: Initiating and Sustaining Change," *Civilisations* 20, no. 4 (1970), 473. The Agricultural Development, recall, was a Rockefeller institution (recall Mosher, above, was its director). This kind of collaboration, as

perspective by arguing that this co-productive relationship between technology and organization often failed when technology was first introduced in order to induce institutional change, because institutional barriers often blocked the successful germination of new technologies. This is why they insisted that institutional change was a prerequisite for the adoption of new technologies imported from elsewhere. Not only was institutional change necessary for successful technoscientific agricultural change, but, in fact, institutional change had to come first. In my survey of the Green Revolution and technological diffusion literature it is Coward and Schutjer who made the first overt suggestion that the Green Revolution could be used as a social-scientific test case to examine their conjecture that institutional change was required as a precondition for the successful importation of new technologies, stating that "unless such difficulties are resolved through various intervention policies it may be impossible to sustain the initial technological changes."[59] Mexico, then, under Rockefeller management, was to become both a technoscientific and a social scientific laboratory, producing both agronomic and geopolitical changes exportable to other Southern hotspots where food insecurity might foment communist agitation.

Coward went further three years later in his "Sociocultural Innovation and Developmental Change" when he described this diffusion strategy as resulting in a "'*social engineering*' strategy which also attempts to separate the tasks of innovation designing from innovation using."[60] In "The Green Revolution: Initiating and Sustaining Change" Coward and Schutjer established a framework for this kind of development sequence: "(1) significant technological change can be *initiated* with little

between Coward and Schutjer, between an academic social scientist and a development agent is common among my informants.

[59] Coward and Schutjer, "The Green Revolution," 473.

[60] E. Walter Coward, "Sociocultural Innovation and Developmental Change," *Philippine Sociological Review* 21, no. 3-4 (Jul.-Oct. 1973), 239.

prior change in institutional patterns; but (2) this will have important influences on the *pattern* of participation in the development process; and (3) will require subsequent institutional changes if the development process is to be sustained."[61] The first principle of this framework was explained within the Achesonian "Limited Goods" paradigm of essential "peasant" innovativeness. Coward and Schutjer admitted that technological change could be initiated without significant institutional change because existing cultural structures were diverse enough to contain some individuals with *access to credit, markets, and information*, and in possession of large enough and therefore risk-insulated holdings, concluding simply that these "[i]nstitutional patterns that create a skewed distribution of wealth, status and power plus new technology produce a *productive but inequitable* agricultural sector (emphasis mine)."[62] Those few individuals in the community with the prerequisite resources for capital investment would disproportionately benefit from the initial technoscientific intervention before the eventual sociocultural institutional intervention could subsidize capital-strapped smaller-holder farmers.

Coward and Schutjer touched upon all of the systematic economic and sociological approaches to the Green Revolution: they understood the co-production of technological and socio-cultural development packages; they insisted on the necessity of exogenous institutional change in technoscientific intervention; and they conceived of this institutional change in mechanistic terms as "social engineering." They suggested that Green Revolution outcomes should be used as social-scientific case studies to better understand (and more effectively implement) technological interventions, and provided later economists and sociologists with an early warning sign of the increasingly apparent socio-economic inequalities of Green Revolution

[61] Coward and Schutjer, "Sociocultural Innovation,"473.
[62] Coward and Schutjer, "Sociocultural Innovation," 477.

interventions. Other economic and anthropological scholarship from the period built upon these themes, exemplifying the co-production of techno- and social-scientific labor in development interventions and highlighting the widening gap between Green Revolution promises and outcomes.

These debates about the interdependence and proper sequencing of institutional and technological intervention were brought directly to bear upon the Rockefeller Foundation Green Revolution program by V.W. Ruttan and Yujiro Hayami. Ruttan was a professor of agricultural economics and director of the Economic Development Center at the University of Minnesota; Hayami was an economics professor at Tokyo Metropolitan University. Their 1973 article, "Technology Transfer and Agricultural Development" was funded in part by the Rockefeller Foundation. Their work mirrored Coward and Schutjer's model that technological transfer can occur initially without institutional change but will founder unless those institutional/cultural changes are soon made, but looked for a way to prevent that foundering from happening to the Rockefeller program in Mexico by elaborating three alternative paths to agricultural diffusion: material transfer, design transfer, capacity transfer. In agricultural cases the simple "material transfer" of seeds, inputs, and machinery proves to be a poor fit in the target locale. Those technologies were designed or bred to perform in a specific cultural and ecological context. In "design transfer" those technologies are reproduced as closely as possible from within the target locale, eliminating the cost of importation, but remaining as ill-adapted — they are still the same technologies developed for a different locale. The "capacity transfer" stage remedied all of these problems. Ruttan and Hayami touted the Rockefeller program in Mexico for attaining this stage of diffusion.[63]

[63] V. W. Ruttan and Yujiro Hayami, "Technology Transfer and Agricultural Development," *Technology and Culture* 14, no. 2 (April 1973), 124.

"Capacity transfer," for Ruttan and Hayami, was the technical name of the process by which an external governmental or para-governmental entity links the importation of new technologies to a sweeping overhaul of knowledge-making institutions and mentalities in the target population. By "capacity transfer" Ruttan and Hayami specifically meant the transfer of scientists from the U.S. to Mexico and the subsequent establishment of an agricultural experiment station system, in effect, an institutional adjustment to the desired technologies urged by Mosher, and Coward and Schutjer. The plant geneticists, entomologists, and soil scientists the Rockefeller Foundation transplanted from the temperate U.S. to Mexico were sent to develop cultivars (and their associated ideal fertilizer, water, and biocide regimens) specifically adapted to Mexico.[64] But for Ruttan and Hayami, capacity transfer was much more involved than the temporary loan of scientists. The ultimate aim of capacity transfer was to establish a Mexican system of agronomic education, research, and development. Institutionalization of Northern academic agronomic training models would occur first by sending young Mexicans to the United States to receive training from American universities and, upon returning, they were to reconfigure Mexican agronomic educational practices in the image of the American technoscientific agronomic curriculum. The institutional overhaul promulgated by the Rockefeller Foundation Mexican Agriculture Program likewise involved the expansion of extension agencies to connect the centralized elite schools of agronomy and Rockefeller experiment stations to Mexican farmers. These three institutional developments were mutually reinforcing and co-productive: the extension outposts and experiment stations incentivized the

[64] Mexico is of course, not an ecological or climatic locality, but dozens of ecological zones peppered with hundreds of microclimatic niches, though Rockefeller scientists seemed unaware or uninterested in these distinctions at first. Their development of High Yielding Varieties for only small subsets of the Mexican countryside, suspiciously often those held by large landowners with pre-existing investments in irrigation, would lead to early criticisms of the program for its narrow range of efficacy and inequitable distribution of benefits.

reconfiguration of educational system by creating employment demand for technically-trained professionals; the agricultural colleges helped the experiment and extension stations to identify prospective agronomists; the experiment stations provided practical training grounds and pre-packaged thesis projects for agricultural sciences students to perform for their degrees; the experiment stations generated new cultivars and input regimes to be communicated to the extension outpost; and the extension outposts liaised between the experiment stations and farmers.[65]

These three institutional components and their synergistic reinforcement led Ruttan and Hayami to commend the Rockefeller agricultural program as "the evolution of an institutional pattern for the organization of scientific resources which can be replicated for a wide variety of crops and localities with a reasonable probability of success."[66] They considered this the "most important contribution" of the Rockefeller programs because

> It is now possible to organize a multidisciplinary team of biological, physical, and *social* scientists [trained by the agricultural universities] capable of adapting any new biological and chemical technology for crop production to local growing conditions [at experiment stations] and to make this technology available to farmers in a form that they are capable of accepting within the relatively short period of five to ten years [through extension outpost education outreach] (emphasis mine).[67]

What Ruttan and Hayami revealed is that the Rockefeller endeavor in Mexico was not developed merely to gift agricultural technologies to Mexico. Its most important accomplishment was replacing the indigenous Mexican system of agricultural knowledge-making with a complex institutional apparatus for the maintenance of Northern technoscientific training, attitudes, and methods (re)produced by the mutually reinforcing university curricula, experiment stations, and extension outposts.

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[65] Ruttan and Hayami, "Technology Transfer and Agricultural Development," 143-44.
[66] Ruttan and Hayami, "Technology Transfer and Agricultural Development," 145.
[67] Ruttan and Hayami, "Technology Transfer and Agricultural Development," 145.

The Rockefeller program in Mexico indeed supplanted the extant Mexican knowledge-cultivating apparatus with a Northern scientific knowledge-manufacturing and -distributing apparatus, but the Rockefeller program resulted in a product that would extend far beyond its original boundaries. The Rockefeller Foundation had created a model for supplanting indigenous knowledge-cultivating apparatuses anywhere. This programmable model of epistemic colonialism was the real triumph Ruttan and Hayami saw in the Rockefeller operation in Mexico.

The "capacity transfer" process enacted by the Rockefeller Foundation in Mexico and described by Ruttan and Hayami elaborated a causal relationship between technoscientific intervention and the reconfiguration of the epistemic institutions and mentalities of the target population. It also revealed agriculture to be an especially suitable avenue for overhauling indigenous epistemologies. Unlike Latour's immutable mobiles (mostly writings and mechanical experimental devices that read or work the same way almost anywhere) agricultural technologies are embedded within ecological and cultural localities — even the transferability of immaterial agricultural *techniques* is contingent upon ecological, climatic, and cultural conditions. For these reasons, for agricultural (or any biotechnological) intervention the "material transfer" and "design transfer" types of technoscientific intervention are inadequate. The successful transfer of agricultural technology requires the "capacity transfer" method of technological diffusion, necessitating a colonial intervention in the epistemic institutions and mentalities of the target population.

Among the development and diffusion theorists I surveyed, Ruttan and Hayami were the only ones to state outright the colonialist resonance of technological transfer. Although never with a critical approach, at three different points in their article they compared the institutional changes implemented under Rockefeller agro-development to colonial institutions with remarkably analogous mandates, placing both sets of

institutions within a shared lineage.[68] They linked the diffusion process to the great colonial trading companies (drawing a silent but uncanny resemblance between those companies and the Cold War development NGOs and American agro-chemical companies supplying fertilizer, various biocides, and machinery). They contrasted the export-oriented cash crops incentivized by colonial governments to the staple-food promotions of later 20th-century development organizations (an important but not exculpatory distinction). And they made sure to highlight that the colonial institutions, likewise, established research centers under British, Dutch, and Belgian directives for the promotion of agricultural development. Understanding the ways in which neo-colonial development projects incorporate or deviate from their traditional colonial inheritances presents promising, if a tad too far afield for this thesis, prospects for future research at the intersection of technoscience and state power. But Ruttan and Hayami are the only of the economic development and technological diffusion theorists surveyed here to make this analogy. While the anthropological theorists from the period take an altogether different approach, with less emphasis on the quantification of human decision-making and a noticeably keener awareness of the colonialist implications of social-scientific development work, the economists conducting case studies ignore any colonial implications of their work.

Economic and Econometric Case Studies

Perhaps commentary on the colonialist implications of development studies was outside the acceptable norms for economic case studies. In lock step they applied and elaborated the econometric approaches outlined above by Ruttan and Hayami; Coward and Schutjer; Katz, Levin, and Hamilton; and Mosher. William I. Jones, for example, was a lecturer at the Economic Development Institute, International Bank for

[68] Ruttan and Hayami, "Technology Transfer and Agricultural Development," 120, 138, 141.

Reconstruction and Development when his "Mexico's Puebla Project: Is there Hope for the Minifundias?" was published.[69] In it Jones attempted to synthesize various estimates of profitability and risk to farmers participating in Plan Puebla in Puebla State, and to proffer explanations for the differences between gains that had been promised (and touted to great effect on demonstration farms and by Plan Puebla's information office) and the diminished results experienced instead by farmers trying out the prescribed fertilizer, water, plant density, and biocide recommendations. As a CIMMYT program, Plan Puebla was an outgrowth of the original Rockefeller Mexican Agriculture Program but with a significant difference. Whereas the original program had been predicated on the introduction of high-yielding-varieties (HYV) of seed, no effective HYV alternative could be developed by Rockefeller agronomists for Poblano maize. As Jones stated of the Poblano farmers, "[o]ver half knew about the maize hybrids developed by the Rockefeller program, but only 15% had tried them, and virtually all of these had found them wanting and abandoned them." In short, they found no demonstrative increases in yield relative to the Poblano open-pollinated varieties. Jones agreed with this evaluation, stating that "not one of the hybrids developed and released there was sufficiently superior to the project area's traditional varieties to warrant recommendation."[70] The failure to develop HYVs for the area instead led to the formulation of a new regimen involving higher seeding densities and the application of more and different mixtures of fertilizers.[71]

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[69] Minifundia, in the Latin American agricultural and land-policy context, refers, simply, to small farms, in contrast with the Spanish-colonial and pre-revolutionary (ca. 1910-20) *latifundia* economy of quasi-feudal haciendas. During the revolution, and in subsequent semi-regular bursts of land confiscation and redistribution, the haciendas were allotted to small-holder farmers and collectively-owned but usually individually-worked *ejidal* lands.
[70] William I. Jones, "Mexico's Puebla Project: Is there Hope for the Minifundias?," *Ekistics* 36, no. 217 (Dec. 1973), 395-96.
[71] Jones, "Mexico's Puebla Project," 396.

Put simply, Jones recognized that the failure of the Rockefeller program in Puebla was a technological failure not some cultural or intellectual deficiency of Poblano farmers. Much of Jones's analysis hinged upon the calculation of estimated "cumulative benefit units," an aggregate attempt to balance estimated gains against a calculated risk factor incorporating the availability of credit extended to farmers who experimented with Plan Puebla recommendations. Much less dry was Jones's depiction of the Plan's pitfalls. He noted the many detractors who raised the issue of the project having been started on a "short research base." The term "short research base" was development shorthand for the fact that the Plan fertilizer, plant spacing, and other recommendations were based only on the results from test plots in 1968, which happened to be an abnormally good year for maize. The argument was that these aberrant results were used to create exaggerated expectations of yield increases supposed to follow from application of the prescribed regimen. Jones added three explanations of his own. These explanations, generated by an economist, were both derived from the agro-development technological intervention treated as a case study, and were themselves intended, through Jones's reports to the International Bank for Reconstruction and Development, to be reinfused into the next iteration of Plan Puebla prescriptions.

First, through interviews conducted by Moscardi and Winkelmann, Jones identified risk-aversion as the overriding factor in Poblano farmer decision-making (although not without suggesting that farmers could be using risk-aversion as a pretext to mask some other more important factor that Jones does not feel compelled to explore). From this risk aversion Jones called attention to the fact that the creditors who provided upfront capital for the prescribed inputs (which only a very small percentage of farmers had the liquidity to purchase themselves in advance of the planting) were guaranteed by federal loan insurance. Debtor farmers, on the other

hand, were not guaranteed by the federal government "against famine and difficulty in getting future loans."[72] Second, Jones suggested that the profitability estimates were inflated or were calculated without accounting for enough variance in profitability among farmers. According to Jones, the planners miscalculated the opportunity cost of the increased farm labor required to implement the Plan Puebla regimen, an exercise that subtracted from the time farmers could devote to other income strategies such as laboring in the cities or for hire on other farms. In other words, Jones recognized Plan Puebla as a technological failure, but rather than attempt to understand Poblano resistance to the Plan recommendations in Poblano farmers' own terms, he used Northern perspectives and categories to evaluate the new prescribed input regimens.

Third, Jones tossed in the possibility of what he called "individual variance," simply put, "[e]verywhere, different people respond to the same economic circumstances differently."[73] Echoing Kunkel's flexible insistence on the idiosyncrasy of peasant microeconomic decision-making, though with much more almanack-like simplicity, with "individual variance" Jones opened the Pandora's box of economic development studies. His explanation of "individual variance" conjured up a glaring cognitive dissonance, coming as it did on the heels of recommendations for changes in profitability-estimate procedures and federal crop insurance policy, and at the conclusion of an entire article concerned with evaluating *aggregate* risk analyses of "the" Poblano farmer. Until the very last sentence, Jones's analysis was predicated on the assumption that it was possible for Plan Puebla planners to devise an optimal fertilizer, plant density, and irrigation regimen for all the farmers of Puebla State, and that a federal crop insurance policy could be devised to override the risk-aversion of financially tenuous small-holder farmers. Jones's "Individual variance" undermines

[72] Jones, "Mexico's Puebla Project," 397.
[73] Jones, "Mexico's Puebla Project," 397.

universality. Through the case studies I will discuss this tension between the homogeneity required to make use of an econometric algorithm for centralized planning, on the one hand, and the infinite variability of microclimatic and ecological conditions and farmer's opportunities, priorities, and constraints, on the other.

Carlos Benito, at the time a professor of agricultural economics at the University of California Berkeley, in "Peasants' Response to Modernization Projects in 'Minifundia' Economies" (1976) challenged the notion that labor-saving technologies would rapidly improve agricultural production. Like Jones above, Benito focused on Puebla and explained the low adoption rates of Plan Puebla recommendations largely through the examination of the opportunity costs of time and uncertainty. His study is immediately recognizable as a conscious application of the development/diffusion debates outlined above. He categorized contemporaneous debates into three components, one of which was the "fundamental behavioral rule of peasant families" both in general and under conditions of uncertainty.[74] He proposed that "most" of these potential explanations of peasant microeconomic decision-making could be integrated into a choice model, the purpose of his article. Benito was also conscious of the concerns of the economic development and technological diffusion theorists, such as Mosher, Coward, Schutjer, Ruttan, and Hayami, that the development process dualistically be considered as separate but co-productive processes of technological and institutional intervention, which, he said, was likewise incorporated into his model.

Benito described Plan Puebla as "one of the best-controlled experiments in modernization" that, after seven years of implementation, paradoxically found itself with relatively low rates of adoption. He stoked the exigency for social scientists to solve this "puzzle" by reminding them of the "high priority that various international

[74] Carlos A. Benito, "Peasants' Response to Modernization Projects in "Minifundia" Economies," *American Journal of Agricultural Economics* 58, no. 2 (May 1976), 143.

agencies and national agencies are giving today to modernization projects as a frontal attack on the world food problem."[75] Benito rose to the challenge of that puzzle by condemning "reduced-form models and one-modal explanations of adoption," offering instead, "a structural form representation of the peasant household economy that could incorporate the various factors that explain adoption." This formulation simultaneously demonstrated an awareness of the complexity of mathematizing the personality of an entire class of people, while at the same time lacking awareness of the dubiety of a reductive model to account for "various factors" rather than one.[76] It is tempting when we study economics, or any scientific endeavor, with the aim of rendering its social construction visible, to take the choice cuts of interpersonal relations, institutional arrangements, and cultural presuppositions, and carefully avoid the jargony esoteric innards. With Benito's econometric model of campesinx decision-making, I want to crack the lid of the black box, if only momentarily.[77] In this case, because it is important, however prohibitively arcane these econometric models were, that we consider the formulae used to reduce peasant choice to command-and-controllable variables because mechanistic methods to understand complex organic phenomena were both what American scientists wanted to instill in Mexican agriculturalists and the means they used to fulfill this goal.

Benito's "structural form representation of the peasant household economy" created variables for the total time of the peasant household and then allocated between time spent on agricultural activities and time spent on non-agricultural

[75] Benito, "Peasants' Response to Modernization Projects," 144.
[76] Benito, "Peasants' Response to Modernization Projects," 144.
[77] Unless you are a practicing economist or professional statistician, you can understand why historians of economics shirk away from cracking that lid: economic models are built as recursive loops of algorithms composed of interdependent variables and constants generated from interpolating guessing functions derived from testing previous models against real world results. They are virtually incomprehensible to the novitiate and make for very poor reading.

working activities. The "agricultural time" consisted of actual farming, gathering information about *modern* agricultural practices (gathering information about endogenous agricultural practices was apparently irrelevant), and on organizational activities. The "non-agricultural working activities" were subdivided amongst crafts, trade, and working in the labor market. From here on, Benito concentrated on labor activities alone, apparently without considering the implications of excising from a model of peasant life their participation in craftwork and trade). "Feasible" agronomic practices were modeled using a stochastic production function designed to calculate expected agricultural production as a function of labor time, agro-inputs, services from physical capital, services from human capital, and weather. Feasible, as used here, is a euphemism for practices recommended by Northern agronomists or Mexican agronomists inculcated in the Northern agronomic mode. Also rife with soggy layers of meaning is the insertion of "services from human capital" (defined by Benito as "knowledge and information of agricultural practices"). Benito stated that the introduction of this factor into the model "transforms the technology into an endogenous variable" meaning "[l]ow levels" of this "human capital," represented "knowledge (in some abstract units) of only 'traditional' practices, while high levels indicate knowledge of 'modern' practices."[78] Uncovering the fundamental presuppositions of this stochastic "structural form representation of the peasant household economy" and others like it presents intriguing research opportunities with the potential to generate new kinds of questions for those working under post- and anti-colonial philosophies of history. As much profitable work could be done demystifying what it means, conceptually, to apply a stochastic function to the choices of a person or a group people.

[78] Benito, "Peasants' Response to Modernization Projects," 144-46.

Having elucidated this "structural form representation of the peasant household economy,"this model could be condensed into "a linear programming version in which risk, uncertainty, and information are incorporated by means of a safety-first rule," so that, "by means of plausible assumptions and simplifications, an otherwise dynamic and nonlinear model is transformed into a simpler linear model so that the linear programming algorithm may be used to obtain solutions."[79] What made these assumptions plausible was the acceptance as fact that yields from "traditional" and "modern" farming practices were closely related. This close relation consisted of three factors: they were to be applied under the same ecological conditions; that the empirical model represented the "average" campesinx household in Puebla State; and that the campesinx farmers grew only maize.

Using the linear programming algorithm, Benito applied the model to data from CIMMYT reports based on interviews in order to explain the low adoption rates by small farmers of the Plan Puebla recommendations. The process suffices to explain the econometric approach to modeling and optimizing peasant decision-making: first create a structural model of the peasant household economy based on assumptions about farmers' priorities, possibilities, and aptitudes (and based on assumptions, taken from Northern microeconomic understanding of leisure, labor, time, profit, and investment, about what is relevant or ignorable in a model microeconomy). The endpoint of the linear programming algorithm was the determination of a set of possible feasible solutions.[80] The model's results were then to be applied by econometricians to campesinx household study subjects by plugging in data collected about them by CIMMYT.

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[79] Benito, "Peasants' Response to Modernization Projects," 144.

[80] "Solutions," in this case, does not mean agronomic solutions for peasant adoptions but rather, from statistical analysis, a set of variables which together produce a desired outcome bounded by constraints.

This process constituted a subroutine of the development *program* in two senses. First as an organizational project and, as it can mean in computer science, a recursive algorithm to optimize the results of that project. The output from this econometric peasant decision-making model-generating *subroutine* would be plugged back into to the CIMMYT planners of the Puebla Project, with the variables responsible for the suboptimal results (fertilizer, plant density, water, biocide application, timing schedule, credit requirements, interest rates, etc.) tweaked and published as a new set of recommendations. By executing this formula Benito asserted that "Economists can provide valuable assistance in the design and evaluation of these type of programs if their research is grounded on a model of political economy that takes into account the overall opportunity set of peasant households within each specific socioeconomic structure and a structural form model of the allocation of human time at the household level."[81] Benito's econometric model, as a social scientific intervention, was just one such way social scientific studies co-produced the Green Revolution in Mexico alongside technoscientific interventions. It also represents an instance in which Northern epistemological attitudes and practices like assumptions and models of campesinx behavior were both the transformation development economists sought to induce in Mexican knowledge-making and the means to enact that transformation.

Building off of Benito's work, and, actually, helping to build it as Benito acknowledged his indebtedness to both of them for many of the ideas in his article, Edgardo Moscardi and Alain de Janvry sought to explain the relationship between campesinx attitudes and agricultural technological diffusion. The premise and approach of their 1977 article "Attitudes Toward Risk among Peasants: An Econometric Approach" should sound familiar, as they outlined in the article's abstract:

[81] Benito, "Peasants' Response to Modernization Projects," 150.

> Attitudes toward risk among peasants in Puebla, Mexico, are derived from survey data in a model of safety-first behavior. The measurements of behavior toward risk obtained are then explained by a set of socioeconomic and structural variables that characterize peasant households. Knowledge of the determinants of attitudes toward risk is, in turn, useful for the purpose of tailoring technological recommendations to particular categories of peasants.[82]

With much more explicit intentionality than Benito, Moscardi and de Janvry's article was intended to promote the integration of social scientific analyses of agro-development in Mexico and Rockefeller development policy through Plan Puebla. This was quite literally the case: like Benito, de Janvry was a professor of agricultural and resource economics at the University of California Berkeley, while Moscardi was an economist at the Rockefeller-backed CIMMYT in Mexico. The purpose of their collaboration was to "identify the specific determinants of behavior toward risk and to quantify their impact on decision making," making it possible "to determine packages of technological and institutional practices optimally tailored to peasants' economic behavior. Such packages should greatly enhance the chances of success of rural development programs."[83] As was true of Benito, Moscardi and de Janvry did not ask campesinxs what factors were relevant to the economic maintenance of their households, nor attempted to ascertain campesinxs' personal priorities: they assumed them.

Their model of the campesinx household economy was, however, altogether more limited in scope than Benito's.[84] The question of cognitive capacity was central."Learning" (as with Benito's "human capital increases") was defined by Northern-centric assumptions about how to characterize this variable (recall that

[82] Edgardo Moscardi and Alain de Janvry, "Attitudes Toward Risk among Peasants: An Econometric Approach," *American Journal of Agricultural Economics* 59, no. 4 (Nov. 1977), 710.
[83] Moscardi and de Janvry, "Attitudes toward Risk among Peasants," 710,715-16.
[84] They broke down their model into three categories of variables: the "nature" of the household; its income-generating opportunities; and their access to public institutions.

Benito encoded "traditional" practices as a low level of human capital). Moscardi and de Janvry's presuppositions about campesinx knowledge and technique acquisition, illustratively, are worth reproducing in full:

> Age and years of schooling of the household head and family size are included in the first class of variables. It is generally assumed that, other factors being the same, older farmers tend to be less prone to take risks than younger ones. This should be particularly true in subsistence agriculture where age can hardly imply greater on-the-job experience (which may be thought to be positively associated with risk bearing), since, on the one hand, the *ability to farm under these conditions does not require a lot of experience* and, on the other, opportunities to develop informally new types of skills and to use them profitably are not easily available (emphasis mine).[85]

Moscardi and de Janvry explicitly stated that their evaluation of the risk aversion of campesinxs, the sole aim of their study, was predicated upon these assumptions. These assumptions were often rooted in the false conflation of technological sophistication and cultural or intellectual sophistication of the kind so thoroughly demonstrated by Michael Adas in his *Machines as the Measure of Man*. More illuminatingly, these assumptions reveal the underlying argumentative utility of "risk-aversion": speaking of campesinx behavior in terms of risk, and modeling economic analyses around the presuppositions about the primacy of the risk-aversion attitude, served to target campesinx traditionalism as the reason for the failure of an attempted technological diffusion.

Benito's and Moscardi and de Janvry's articles exemplified the econometric model of peasant decision-making and simultaneously placed the onus of diffusion failure on campesinx communities while locating the agency of correcting this "risk-aversion" in the hands of development institutions. Alternatively, Robert V. Burke sought to determine whether responsibility for the low adoption rates of Plan Puebla inhered in the technology itself. Burke used the 1970 *Censos Agricola-Ganadero y*

[85] Moscardi and de Janvry, "Attitudes toward Risk among Peasants," 713.

Ejidal (Agricultural/Livestock Ejidal Census) to answer this question in his article "Green Revolution Technologies and Farm Class in Mexico". At the time Burke was an employee of the U.S. Treasury Department; it is unclear whether this work was related to his role at the Treasury, as it was an extension of his Ph.D. research. The 1970 *Censos Agricola* recorded *municipio*-level data for all but four of the Mexican states: Michoacan, Veracruz, Oaxaca, and Chiapas.[86] Significantly, these states contain significant indigenous populations.[87]

Burke was investigating, through regression analyses, the supposed neutrality, with regard to scale, of the biological and chemical technologies (seeds, fertilizers, and biocides) of the Green Revolution. This presumed neutrality was rooted in their materiality, namely in the near infinite divisibility of these inputs.[88] A farmer could plant one hectare of HYV seed, add one hectare's worth of fertilizer, pesticide, herbicide, and fungicide, and it would, according to this logic, produce the same yield as a well endowed farmer planting fifty hectares. In contrast, one could not similarly subdivide a thresher, harrow, or tractor. Using fertilizer application as a benchmark to which other elements of Plan Puebla were pegged, Burke, however, found significant differences between the fertilizer coefficients of large private farms on the one hand, and small private farms and *ejidos*, on the other. He attributed this finding to the contrasting capital intensivity of the large private farms and the land intensivity of the small private farms and *ejidos*. This was especially problematic because the explicit mission of Plan Puebla was "to . . . obtain a massive increase in yields of a basic food

[86] The *municipio* in Mexico is roughly equivalent to the county in the United States.
[87] Although identifying demographic breakdowns along ethnolinguistic lines is difficult in Mexico (and estimates were poor in 1979 when Burke's article was published), in 2010, Oaxaca, Chiapas, Veracruz, and Michoacan ranked first, second, third, and twelfth by total indigenous population, accounting for roughly half the indigenous population of the 31 states. (http://cuentame.inegi.org.mx/poblacion/lindigena.aspx?tema=P)
[88] Robert V. Burke, "Green Revolution Technologies and Farm Class in Mexico," *Economic Development and Cultural Change* 28, no. 1 (Oct. 1979), 135-154.

crop among smallholder farmers — those who are usually the last to adopt new technology."[89]

All of the economic cases studies presented here, from 1973 to 1979, appear to approach the diffusion failure of agricultural technologies at the point of consumption. Their analyses all attempted to understand the failure of Green Revolution programs in the hands of farmers, rather than investigate the social dynamics of the agricultural extension agency or the research station. This apparent focus on the farmer allowed Jones, Benito, Moscardi, and De Janvy to situate the locus of responsibility, and blame, for the adoption failure of Green Revolution technologies on campesinx farmers. Only Burke considered that the locus of responsibility could lie with the false scale-neutrality of the technologies themselves, and he only began to suggest this possibility by studying adoption failure in the campesinx community; he did not follow this investigation back to the design process of these technologies. But these studies only *appear* to produce their analyses from the consumption junction. Jones's conclusions were drawn from CIMMYT reports of adoption failure and interviews conducted by Winkelmann and Moscardi; Benito's and Moscardi and De Janvry's econometric models were run with data gleaned from CIMMYT reports; Burke's analysis was based on data from the 1970 *Censos Agricola-Ganadero y Ejidal*. None of these studies attempted to elicit the decision-making criteria from campesinx farmers themselves. These analyses were only positioned at the consumption junction through various intermediary studies. Furthermore, none of these economic case studies attempted to scrutinize the technological development process *from the perspective of the consumer*. Jones's analysis was presented from the perspective of other development

[89] Centro Internacional de Mejoramiento de Maiz y Trigo, *The Plan Puebla Project, 1967-69: Progress Report of a Program to Rapidly Increase Corn Yields on Small Holdings* (CIMMYT: 1969), accessed April 7, 2018, https://repository.cimmyt.org/xmlui/handle/10883/3575

economists. Benito's and Moscardi and De Janvry's models were predicated on standard *assumptions* from growth and development economics like profit-maximization and risk-abatement, and not on priorities ascertained from campesinx farmers themselves. Although unintentionally, Jones's third explanation for adoption failure, "individual variance," suggested a much more pervasive impediment to development economics. His anti-generalizing generalization, "everywhere, different people respond to the same economic circumstances differently," unwittingly provided an impetus to eschew rationalizing and totalizing assumptions about decision-making behavior derived from the perspective of Northern capitalist household priorities, and instead to base explanations of campesinx farmer decisions on the farmers' own priorities and values ascertained from intimate contact with farming communities and farmers themselves.

Ethnographic Field Studies

Social Scientists trained to use ethnographic practices and refocus their research gaze to empathize with the perspective of their study subjects were primely positioned to study the adoption failure of Green Revolution technologies at the point of consumption, both physically and analytically, and to see the technological production and diffusion process from the vantage point of the campesinx farmer. For example, whereas Robert Burke sought only to demonstrate the adoption failure of Plan Puebla and suggested that failure be attached to the misunderstood neutrality of the Green Revolution technologies, David Clawson and Don Hoy went further and determined to explain *why* a *specific community* rejected the Green Revolution.

Their "Nealtican, Mexico: A Peasant Community That Rejected the 'Green Revolution'" was unique in economics journals in that it attempted to uncover the Nealticanos' own logics for rejecting the HYV seeds, rather than simply ascribe that failure to miscalculated incentives, insurance rates, promised yields, or input

recommendations — in other words, they upheld the agency of the Mexican small-holder farmers they studied, rather than assuming the farmers to be econometrically codifiable and economically "rational" and therefore reducible to manipulable variables. Clawson and Hoy challenged the fundamental assumption, common among Northerners, that the innovations promoted in the Green Revolution would be beneficial to farmers. Theirs is the only field study in Mexico published in an economics journal I have found that challenged this most basic presupposition of the Green Revolution: "[t]his somewhat ethnocentric attitude," Clawson and Hoy contend, "implies a belief that the farmers who have rejected the Green Revolution have been unable to recognize what is best for them," harkening back to debates about campesinx innovativeness.[90] To that end, Clawson and Hoy identified six factors important to Nealticanos in their decision not to use HYV seeds: (1) the small kernel count per cob; (2) the drastically shorter stalk of the dwarf varieties of maize; (3) the susceptibility of the hybrids to corn worm infestation; (4) the season-to-season degeneration of hybrid maize yields necessitating frequent purchases of new seed stock; (5) the disagreeable taste and texture of the hybrids; and (6) the regimentation of the planting and harvesting schedule for HYVs, and monoculture in general. I will investigate some of these reasons, and issues Nealticanos took with other components of Plan Puebla in greater detail. It must be kept in mind, though, that some of these factors *were* part of development agents' prescriptions and *were* variables in economists' models. The point, for Clawson and Hoy, however, is that these concerns were based on the testimony of the farmers themselves and not by presumption. Clawson and Hoy's insistence on this matter also enabled them to identify decision-making factors of

[90] David Clawson and Don Hoy, "Nealtican, Mexico: A Peasant Community That Rejected the 'Green Revolution'," *The American Journal of Economics and Sociology* 38, no. 4 (October 1979), 372.

importance to local farmers that were ignored altogether by development agents and economists. Their approach exposed the assumptions of these agents and, in the process, interrogated the universality of the Northern scheme for understanding productivity, labor, profit, and the value of time.

The drastically shorter stock of the dwarf varieties was considered by Rockefeller agronomists to be the paramount innovation of HYV seeds. The Green Revolution plan, from the perspective of plant genetics, was to increase yield by increasing the receptiveness of the plant to fertilizer; the shorter stalk made this possible in two ways: that more of the nutrients provided by the fertilizer were converted into grain and there was a decreased likelihood that the plant, top heavy from the enlarged cobs, would topple over. Taken purely from the priorities of Rockefeller plant geneticists, the short-stalked dwarf varieties were essential to unlocking the potential of synthetic fertilizer. From the perspective of Nealtican farmers, however, who used corn stalks to feed their animals through the arid winter, the dwarf varieties either created a new source of food insecurity or forced them to purchase animal feed. Likewise, the HYV susceptibility to corn worm infestation forced the Nealticano farmers to purchase insecticides. The degeneration of the seed stock after only two or three years forced them to frequently purchase new seed. With open-pollinated local maize cultivars, a portion of seed withheld from the previous harvest could be planted with no degeneration in yield because the open-pollinated varieties maintained their rigor by cross-pollinating with other nearby cultivars. Although completely ignored by economists and development planners concerned only with the yield and the maintenance of essential nutrients (mostly for caloric value), the taste and texture of the corn was also of great importance to Nealticano farmers. Subsistence and near subsistence farmers in Mexico depended on maize as their staple — they ate it at

every meal and it constituted the majority of their caloric intake — and its palatability was therefore of great importance.[91]

The sixth reason Nealticanos rejected the HYV seeds, and the one Clawson and Hoy insisted was of the most critical to their informants, was the regimentation of the HYV planting and harvesting cycle. To understand its importance one must understand the staggered polyculture system developed and sustained by Mexican campesinxs over the centuries. This system was flexibly adaptive to seasonal climatic and insect-population flux and was co-produced with agricultural seasonality and Mexican campesinx lifeways synced with religious and cosmological calendrical cyclicality. In these regards, Nealtican disaffection with the HYV planting and harvesting schedule serves to highlight the chasm between Northern agronomic priorities, approaches to the value of human labor, the meaning of security, and the linear conception of time, on the one hand, and the indigenous and mestizo campesinx Mexican alternatives, on the other, underscoring the hostility of the Northern technoscientific development regime to campesinx lifeways. Ancestrally, Nealticans had selected for and cultivated four strains of maize, identifiable by color: yellow, white, blue, and red. Each had different cob weights, yields, ideal planting dates, and gestation periods.

Yellow was the heaviest, had the highest yield, and took the longest to mature, followed by white, blue, and red. Although these variances in yield, planting date, weight, and gestation period do not lend multicolored maize polyculture to the standardization ideal for industrial monoculture, they do make possible a system of crop insurance and dietary variance. The industrial capitalist approach to maize farming in Nealtican would probably have privileged the yellow variety, as it excelled in yield — the supreme Northern crop virtue — but, in actuality, the Nealticanos surveyed

[91] Clawson and Hoy, "Nealtican, Mexico," 379-80.

by Clawson and Hoy disliked its taste and considered it only fit for animal feed. For human consumption, Nealticanos planted white maize approximately six months before the expected first frost in September; two weeks later, in the event of a less than desirable sprouting of the white maize stalks, blue maize was planted; finally, two weeks later, again as needed, red maize was sown. With this four-cultivar system, the Nealticanos afforded themselves a month of meteorological flexibility to ensure that a robust crop was planted. Moreover, their cultivars were resistant to corn worm and the polyculture prevented any one blight or pest from decimating their whole crop; and between the yellow corn and the tall stalks of all four cultivars, they had animal fodder throughout the dry winter season.[92]

Measuredly taking this in, and noticing the compatibility of the Nealticano's agricultural system with their specific ecological conditions, aesthetic preferences, and conceptions of leisure, labor, and security, Clawson and Hoy recommended that "rather than endeavoring to change the peasant to be compatible with the Green Revolution, we can attempt to modify the Green Revolution products to be compatible with the peasant's world."[93] As for the incompatibility of the HYVs to the Poblano environment and the Plan Puebla system of dividing all of Puebla State into "cold," "hot," and "temperate" zones (Nealticanos were "temperate, apparently), which "resulted in a program not adapted to any single village," Clawson and Hoy had this to say:

> Such a course of action will require an increased emphasis on and recognition of the environmental diversity that characterizes the world of potential Green Revolution adopters. One promising method of achieving this is the ecological systems approach which stresses the integration of physical and social phenomena rather than the study of a problem from the viewpoint of a single discipline. . . . Our challenge now is to . . . adapt the Green Revolution to the location-specific needs of the small farmer. This will be more difficult and slower than the initial gains among large landholders.[94]

[92] Clawson and Hoy, "Nealtican, Mexico," 377-378.
[93] Clawson and Hoy, "Nealtican, Mexico," 384.
[94] Clawson and Hoy, "Nealtican, Mexico," 385.

The tension, recognized by Jones above, between the homogeneity necessary for algorithmic calculation and centralized planning on the one hand, and the infinite variability of microclimatic, ecological, and cultural conditions and farmer's opportunities, priorities, and constraints on the other, if only alluded to in Jones's, Benito's, and Moscardi and de Janvry's articles, became unavoidable in Clawson and Hoy's. Neither Benito's nor Moscardi and de Janvry's models factored in whether Poblano farmers liked the taste of HYVs or whether they were integratable with a Poblano community's system of animal husbandry. The issue of security was resolved by crop insurance that did not cover their losses, did not provide them with seed for next year's planting, and that by and large they could not afford. Clawson and Hoy thus challenged the fundamental premises of Rockefeller agents, diffusion theorists, and development economists.

Clawson and Hoy did not, however, question exogenous development itself. The "challenge" they referred to in the above excerpt, and the first person plural pronoun they used to involve themselves and their work in that challenge, places them under the umbrella of social science in the service of development. Perhaps a reason that Clawson and Hoy's methodological approach and conclusions are such a radical departure, though, from those of Benito and Moscardi & de Janvry, despite appearing in the annals of the *American Journal of Economics and Sociology*, was that Clawson and Hoy were trained as geographers, not economists. Their attitude will appear much more comfortable in the company of the anthropologists.

The anthropologists examined here were aware of the hazardous implications of academic colonialism and were often critically self-conscious of the power asymmetry between themselves and their study subjects. But like the geographers Clawson and Hoy, not all anthropologists saw their work as external to and in conflict with the goals of the Rockefeller Foundation in Mexico. Christina H. Gladwin, for example, was

employed at the International Fertilizer Development Center, an outgrowth of the Tennessee Valley Authority and sponsored by USAID, between 1976 and 1979. Although Gladwin operated as an economic anthropologist employed in the development industry, she was overtly antagonistic to the econometric framework. In "Production Functions and Decision Models: Complementary Models" she questioned the very nature of econometric approaches to decision-making by undermining the "maximization assumption." The econometric studies described above all assumed campesinxs maximize profit and minimize risk (the "safety-first rule"), or do one or both of those two things while accounting for some small set of constraints. Problematically, as Gladwin incisively pointed out, standard econometric evaluation merely "tests the maximization assumption itself and does not test models of farmers' actual decisions."[95] Further degrading the foundational premises of these econometric models, Gladwin argued that their behavioral assumptions and the few constraints they incorporated were drastically too simple to account for the logics of decision-making she uncovered in her interviews. To ameliorate the deficiencies of the production function models and the maximization behavioral assumption upon which they were based, Gladwin proposed an alternative model-making process: the decision tree.

Her decision tree model, applied to an unspecified village targeted by Plan Puebla, showed that "an understanding of the *logic* behind the production decisions that comprise the traditional way, rather than just surveys gathering *data* on socioeconomic status and *facts* about production, is necessary for a successful rural development project." Such observations directly challenged econometric analyses (she pointed to Moscardi by name). Like Clawson and Hoy, she emphasized the importance of the internal cultural logics of those she studied, rather than presuming that they

[95] Christina H. Gladwin, "Production Functions and Decision Models: Complementary Models," *American Ethnologist* 6, no. 4 (Nov. 1979), 653.

operated under the same priorities and economic motives as the Northern consumers on whom microeconomic models were originally trained — that is she evaluated Mexican farmers' decisions according to their epistemic frameworks, not her own.[96]

How Gladwin's decision tree models were generated is best shown anecdotally. She began by identifying farmers who applied differential methodological decisions on different parcels of their land — fertilizing, planting, or irrigating one parcel differently from another — so that she could ask, "Why did you do this in *X* but that in *Y*?" She found a farmer who made the decision to fertilize some of his fields at planting time, while leaving some of his recently sown corn unfertilized until the corn had sprouted. He responded that he only fertilized at planting if the earth was very moist, so that the fertilizer could dissolve into the soil (a prerequisite for fertilizer uptake). Gladwin reconfigured his response into a possible decision criterion and tested it by asking, "Do you think it would be dangerous for the plants if you threw fertilizer at planting, even though the earth is moist?" on her questionnaire to other farmers.[97] She conceived of the farmer's choice to only fertilize if the soil was moist as an instance of risk-aversion, which is why she framed the question as "would it be dangerous . . .?" "Unfortunately" Gladwin stated, this decision-criterion did not "predict" what the farmer *would do*, as he had already *not* done it. By "predict" she meant that he answered her question "no". As with the first farmer, she asked him why it was that he did not fertilize at planting and the farmer responded that he

> did not have irrigation like the previous farmer, and the humidity of nonirrigated land after rain in April (planting time) was not like the humidity of land after irrigation so that the fertilizer would not dissolve if it was thrown on nonirrigated land after a rain in April. While he did not think it was dangerous for the seed in the ground to have undissolved fertilizer sitting on top of the ground, he did not

[96] Christina H. Gladwin, "Cognitive Strategies and Adoption Decisions: A Case Study of Nonadoption of an Agronomic Recommendation," *Economic Development and Cultural Change* 28, no. 1 (Oct. 1979), 170.
[97] Gladwin, "Cognitive Strategies," 161-62.

> think that the possibility of the plants' drying out later if the rains stopped was greater for plants with fertilizer than for plants without fertilizer.[98]

In light of this response, she reconceptualized the criterion from one of risk-aversion into a utility criterion. The second farmer found that his soil-moisture level, maintained only precariously by rain, was inadequate for properly dissolving fertilizer into the soil; he did not believe it damaged the plants if left on the soil surface, only that it was totally ineffective, and so he waited for more rain before fertilizing.

In this recursive fashion, eliciting responses from farmers through interviews, crafting possible decision-making criteria from them, testing those criteria by posing them to other farmers, and reformulating the potential criteria in light of their responses and so on, Gladwin constructed her decision tree model. Simply by asking farmers to explain their decisions in their terms went well beyond the assumptions of previous econometric analyses; more importantly still, she did not allow her initial interpretation of the initial round of interviews (in this case that the decision not to fertilize was an act of risk-aversion) to suffice for her model, reiteratively testing her interpretations against the testimony of other farmers.

After she felt that the decision criteria corresponded with the interviewed subset (25 responses) of farmers' decisions, the next step was to "[use] the language and categories that the decision makers themselves use [to] put the decision criteria into a flowchart," and to make sure that the flowchart was "descriptively adequate" by testing it against the decisions made by the subset of interviewed farmers from whom the decision criteria were originally derived.[99] At this point in the model-building process, agency had been placed firmly in the hands of the community Gladwin studied. The next step, however, warrants closer inspection. At this point, Gladwin translated the

[98] Gladwin, "Cognitive Strategies," 161-62.
[99] Christina H. Gladwin, "A View of the Plan Puebla: An Application of Hierarchical Decision Models," *American Journal of Agricultural Economics* 58, no. 5 (Dec. 1976), 882.

tree constructed with the farmers' own words using an "economic interpretation" to "find the underlying ordering aspect and constraints of the theory. Depending on what the flowchart says, the alternatives can be ordered on any aspect: profit, cost, risk, welfare of the group, etc."[100] She then tested the model against the adoption decisions of a second subset of farmers (34 responses). One of the trees' results looks like this:[101]

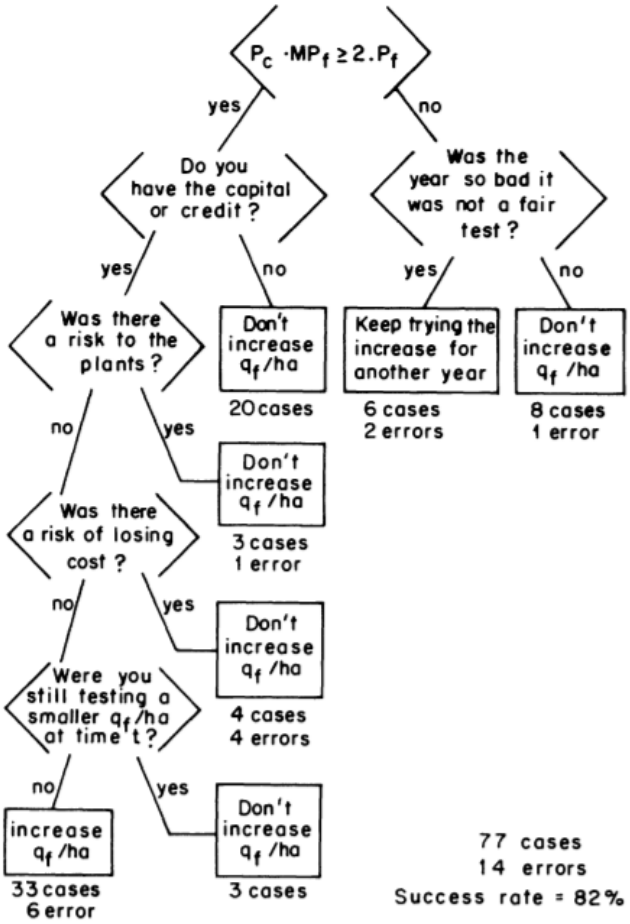

Figure 1. Subroutine INCQF

The unintelligible formula at the top level of this tree was a profitability criterion asking if the value of the marginal product of fertilizer is at least two times its marginal cost or price. "Error" in this case was not a judgment of the farmers' decisions, but of the

[100] Gladwin, "A View of the Plan Puebla," 882.
[101] Gladwin, "A View of the Plan Puebla," 883.

model; it meant that the farmer in question made the set of decisions leading to that leaf of the tree, but either increased their fertilizer use (the adoption decision for this tree) when the farmers from whose interviews the tree was crafted did not, or the inverse (these end results are contained in rectangles).

Gladwin's decision tree model was intended to understand farmers' own reasons for non-adoption whereas Benito's and Moscardi & de Janvry's models tested the (maximization and minimization) assumptions they made about farmers, as Gladwin pointed out. However, because Gladwin reformulated the model in terms of economic constraints (profit, risk, capital, and knowledge) as she understood them before testing the model, she could as well have accused her own model of testing her conceptions of these constraints. For example, her ethnographic work did not attempt to ascertain the importance that the farmers placed on profit relative to food security or of their attitudes to accruing capital. Gladwin's knowledge constraints — her rewording of the farmers' responses into the language of the agronomic planners— treated "knowledge" as synonymous with exposure to Plan Puebla recommendations, and did not include access to knowledge of alternative techniques or input regimens, or access to information critical of, and countervailing to, Plan Puebla recommendations. Although she frequently reminded readers that "[t]he two aims of a decision study should be to identify decision factors amenable to policy variation and to recommend changes that will speed up adoption of a project's recommendations," she failed to self-critically consider the conflict of interest between the mission-oriented objective she brought to the village and that she shared with her employer, and what she considered to be the "successful" path through the decision tree (the left-most path). As she put it, "The problem of statistical significance of each path on a tree can be thought of as a

quality-control problem: the farmers are passing through quality criteria designed to weed out the noninnovators."[102]

Gladwin undermined some of the basic presuppositions of development-oriented econometric analysis and was forcefully critical of the behavioral assumptions built into Benito's and Moscardi & de Janvry's models. As an economic anthropologist, she introduced innovations into the pragmatics of development economics field work, but she did not alter the basic routine concerning the relationship between the technoscientific intervention and social scientific intervention components of a development regime. A development program was utilized as a case study; Gladwin collected data from the campesinxs affected by that case study; she created a model of campesinx behavior (although not one predicated on assumptions about that behavior); and she tested her model against campesinx behavior so that the results could be used to tweak the next iteration of that technoscientific intervention package. Even though her work mapped directly onto this pattern, she proposed another innovation in the social-scientific intervention subroutine by suggesting that decision trees be employed at an earlier stage of the technological intervention subroutine, just after the ("limited release") pretest but before the intervention to the subject population at large, arguing for a more intricately enmeshed interdependency between the technological and social-scientific intervention subroutines "with the aim of speeding up the diffusion process."[103]

Gladwin set out to challenge the foundational assumptions of econometric modeling in agro-development but did so in order to quicken the pace of technoscientific intervention. In other words, she changed the rules but not the game. Billie DeWalt, an anthropologist at the University of Kentucky, went further by

[102] Gladwin, "A View of the Plan Puebla," 883n1.
[103] Gladwin, "A View of the Plan Puebla, 886.

challenging the very notions of induced "modernization" and "development" in Mexican agriculture, criticizing the ethnocentrism of those terms. In his 1979 "Alternative Adaptive Strategies in a Mexican Ejido: A New Perspective on Modernization and Development," he argued that technological change should instead be viewed as an adaptive process. The ethnocentrism of "development" and "modernization" became all too apparent to DeWalt in his interviews of development agents in the Temascalcingo region when the agents attributed the failure of their development projects to campesinxs whom they described as "uncooperative, apathetic, drunkards, suspicious, resistant to change, and lazy."[104] DeWalt placed his critique in the context of a two pronged assault against contemporaneous conceptions of modernization and development. One the one hand, criticism was coming from those beginning to realize that tradition and modernity were not simply two termini of a dipole. The other critique, also made in the anthropological overviews of the Green Revolution in the following section, was that "our energy-intensive, high-technology way of life may be coming to an end," and that Southern countries did not have to, and perhaps even could not, follow the Northern path traced by industrialization toward global capitalism.[105] DeWalt argued that change in "peasant" society should be reconstrued in biomimetic-metaphoric terms as an evolutionary adaptive process.[106] What he found through his ethnographic work was that when campesinxs were presented with an agro-technological package, they neither rejected nor accepted the package of inputs, seeds, and techniques wholecloth. Nor were they integrating subsets of the package at random. Their adoption choices were intentional and backed by

[104] Billie R. DeWalt, "Alternative Adaptive Strategies in a Mexican Ejido: A New Perspective on Modernization and Development," Human Organization 38, no. 2 (Summer 1979),
[105] DeWalt, "Alternative Adaptive Strategies in a Mexican Ejido," 135.
[106] This is not the place to problematize analogies between biological evolution and cultural evolution, though there is certainly a place.

internally consistent cultural logics.[107] More importantly still, his campesinx informants did not categorize the technologies they used in terms of "traditional" and "modern." For DeWalt, this reframed this dichotomy as an artifact of development theorists and agents as much as an imposition of the technological package itself.[108] Instead, DeWalt's campesinx informants saw the subset of the package as simply an added component of their cultural repertoire, "their major means of coping with the natural and social environment in which they live." In doing so, they created a synthesis of endogenous and induced exogenous techniques and technologies that allowed DeWalt to "detect patterns in the ways in which these elements are combined," and thus "talk of adaptive strategies."[109]

To that aim, DeWalt performed a factor analysis to look for patterns in the adoption decisions of the campesinxs living in the *municipio* of Temascalcingo on *ejidal* land. He found that their adoption choices were not random, but that the Temascalcingan campesinxs were concentrating their investments in those subsets of the intervention package with the potential for synergistic effects, concluding that "an individual's choice of strategies depended on a complex decision-making process and that the strategies adopted were found to be understandable when ecological, economic, political, social, and other variables were taken into account."[110] Extending his biomimetic metaphor of adaptation, DeWalt considered this piece-meal adoption of subsets of technological packages to be "evolutionary", rather than (Green) "revolutionary" adoption. Campesinx decisions were instead a kind of risk-abatement through cautious experimentation. As a result, DeWalt protested against what he

[107] DeWalt, "Alternative Adaptive Strategies in a Mexican Ejido," 136.
[108] DeWalt, "Alternative Adaptive Strategies in a Mexican Ejido," 137.
[109] DeWalt, "Alternative Adaptive Strategies in a Mexican Ejido," 137.
[110] DeWalt, "Alternative Adaptive Strategies in a Mexican Ejido," 139. This is not the place to discuss the implications of the redefinition of "variables" as any kind of factor or element of anything.

viewed as the attempt by development agents to "strive to convert a region to any single adaptive strategy."[111] Playing up the biomimetic metaphor, DeWalt considered this overspecialization to be as dangerous to cultural evolution as it was to biological evolution, instead seeking rigor through intercultural hybridity. After establishing this "adaptation" alternative that campesinxs were already comfortably engaged with on their own terms, DeWalt, as did other social-scientists of this era, once again subordinated his analysis to the purposes of agro-development agents. He proposed ways for agro-development agents to adopt the adaptation-oriented mentality, use factor analysis to understand those adaptations, and to vertically integrate that kind of analysis into their technological-intervention workflow. Agents who saw their charges employing adaptive strategies they predicted would be unsuccessful were to be encouraged to demonstrate alternatives, withhold credit, or "provid[e] them only minimal assistance."[112]

Clawson, Hoy, Gladwin, and DeWalt conducted their studies at the point of consumption. They were in direct contact with the campesinx farmers they studied. Furthermore, they attempted to scrutinize the shortcomings of the Green Revolution technoscientific intervention from the perspective of their campesinx informants using their informants' epistemic outlooks. For these reasons, I read Clawson, Hoy, Gladwin and DeWalt through the lens of Ruth Schwartz Cowan's analytical framework: "the consumption junction" for technology studies. To be clear, I do not here deploy the consumption junction as the methodological approach of this thesis — I do not study the consumers of Green Revolution technologies in Mexico — but instead study those social scientists studying the consumers. Rather, I am suggesting that over the course of the 1970s, social scientists studying agricultural technological diffusion in Mexico

[111] DeWalt, "Alternative Adaptive Strategies in a Mexican Ejido," 141.
[112] DeWalt, "Alternative Adaptive Strategies in a Mexican Ejido," 142.

began to methodologically develop some tenets of technoscientific studies like those Schwartz Cowan made explicit at the beginning of the 1980s. Schwartz Cowan first began to lay out the parameters of her methodological approach to technology studies at the consumption junction in her pivotal 1983 book *More Work for Mother*, but also provided a succinct overview of its functions, capacities, and limitations in a 1987 book chapter, "The Consumption Junction: A Proposal for Research Strategies in the Sociology of Technology."[113]

Schwartz Cowan saw the consumption junction as the interface at which place and time the consumer makes an adoption (non)decision. This consumer was conceived of as embedded in a network of social relations that constrain and direct the consumer's choices, including technological adoption choices. Schwartz Cowan argued that the network of relations woven between producer and consumer through various intermediaries in the technological diffusion flow should be inverted: rather than studying the relational matrix of a technology with the site of production at the epicenter and the consumer at the periphery, technology studies scholars should reenvision the network with the consumer at the center. Moreso, the scholar of technological diffusion should position their study at this interface (the consumption junction) and turn the critical gaze of their study outward, back upon the rest of the network from the vantage point of the consumer. Traditional studies of the Green Revolution in Mexico concerning themselves with the Mexican Ministry of Agriculture and the Rockefeller Foundation conceived of the network with the technoscientific and

[113] Ruth Schwartz Cowan, *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave* (New York: Basic Books, 1983).
Ruth Schwartz Cowan, "The Consumption Junction: A Proposal for Research Strategies in the Sociology of Technology," in *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, eds. Wiebe E. Bijker, Thomas P. Hughes, Trevor Pinch (Cambridge, MA: MIT Press, 1987), 261-280.

technocratic elites at the center.[114] The case studies in economics detailed above (Jones, Benito, Moscardi, De Janvry, and Burke) did position themselves at the consumption junction (but only through intermediaries), but they scrutinized the decisions of campesinx farmers from the perspective of (and with the same objectives as) the technoscientific interventionists, rather than the inverse that Schwartz Cowan would later recommend. In light of Schwartz Cowan's consumption junction framework, by categorizing 1970s social scientists of development according to the ways in which they arranged the epicenter and periphery of the technological diffusion network and from whose perspective they gazed upon the network, we can situate, if only by one system of coordinate reference, 1970s development-oriented social science in Mexico in the larger landscape of contemporaneous technoscience studies.

Unlike the standard histories of the Green Revolution in Mexico and the case studies in economics presented in this thesis, the ethnographic studies of Clawson, Hoy, Gladwin, and DeWalt can be positioned in the larger landscape of technoscience studies by their configuration of the technological diffusion network with the consumer at the center and their critical approach to the diffusion of Green Revolution agricultural technologies from the epistemic perspective of campesinx farmers. In many ways their work can be seen to prefigure Schwartz Cowan's consumption junction

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[114] E.C. Stakman, Richard Bradfield, and Paul C. Mangelsdorf, *Campaigns Against Hunger* (Cambridge, MA: Harvard UP, 1967).
Arthur T. Mosher, *Technical Co-operation in Latin-American Agriculture* (Chicago: U. of Chicago Press, 1957).
Stanley Johnson, *The Green Revolution* (New York: Harper & Row, 1972).
Lester R. Brown, *Seeds of Change: The Green Revolution and Development in the 1970s* (New York: Praeger, 1970).
Eduardo L. Venezian and William K. Gamble, *The Agricultural Development of Mexico: Its Structure and Growth since 1950* (New York: Praeger, 1969).
Cynthia Hewitt de Alcántara, *Modernizing Mexican Agriculture: Socioeconomic Implications of Technological Change, 1940-1970* (United Nations Research Institute for Social Development, 1976). Though Hewitt de Alcántara's work is largely critical of the Green Revolution intervention in Mexico, it still saw the network of technological diffusion as centered around governmental and development agencies and agents.

framework. When Gladwin criticized the maximization (and other) assumptions and production functions of econometric modellers she was criticizing the algorithmic epistemic attitudes of Northern social scientists and their presuppositions about the universality of Northern consumer values. Her decision tree, though by no means an example of an epistemic practice of the Mexican campesinxs she studied, sought to build a model of agro-technological diffusion failure from the decision-making logics of her informants. Her iterative process of interrogating farmers' decisions, crafting decision criteria from their answers, and testing those criteria against the testimony of other farmers, enabled her to evaluate Green Revolution technology adoption failure from the perspective of her campesinx informants. As Gladwin put it, her adoption decision model was "part of a larger attempt to view the Plan Puebla through the eyes of the proposed adopters of the new technology — the farmers."[115] This iterative process can be seen as an anachronistic application of Schwartz Cowan's recommendation to "try to ascertain how the network may have looked when viewed from the inside out, which elements stood out as being more important, more determinative of choices than the others, and which paths seemed wise to pursue and which too dangerous to contemplate."[116] Gladwin's decision tree flow chart was a model of Schwartz Cowan's "paths".

Clawson and Hoy similarly prefigure of Schwartz Cowan's consumption junction methodology. Their elucidation of six factors contributing to Nealticanos' rejection of Green Revolution technologies is emblematic of Schwartz Cowan's recommendation to view the network from the consumer's point of view. Many of the reasons Nealticanos gave for rejecting the technoscientific intervention package not only were not considered in terms of econometric assumptions about campesinx

[115] Gladwin, "Cognitive Strategies," 156.
[116] Schwartz Cowan, "The Consumption Junction," 263.

behavior, but the epistemic priorities underlying those six reasons were often antithetical to Northern conceptions of economic rationality and technological modernity. The aesthetic taste preferences of Nealticanos for certain varieties of maize were never considered by Rockefeller scientists, who designed the HYVs, as their name makes clear, for yield alone. Likewise, just to point to a second of many possible examples, the Nealticano need for excess maize stalk forage went uncomprehended by Rockefeller scientists and development agents. The dwarf stalks of Green Revolution cultivars were a keystone component of augmenting their yield (by allowing the fertilizer to contribute to the engorgement of the cob and preventing the consequently top heavy plants from toppling). According to the agricultural epistemology of the Nealticano farmer, and doubtless many other campesinx communities, the leftover maize stalk, rather than energetic waste, was an essential component of their community's energetic life web when used to feed animals for meat and dairy through the winter.

DeWalt's accusation of the ethnocentrism of the rhetoric of "modernization" and "development" was a critique from the perspective of the "to be modernized." The "centrism" in the ethnocentrism he saw inherent in the agro-technological intervention of the Green Revolution can be read as the Northern technoscientific gaze from the center of the network of technological diffusion Schwartz Cowan argued against. DeWalt dispensed with the Northern dichotomy of modern and traditional; his informants twisted the "chain of being" put forth by development-oriented social scientists by adopting some of the Rockefeller recommended agricultural technologies, rejecting others in favor of extant indigenous alternatives, and hybridizing their new, supposedly contradictory, combinations of endogenous and exogenous technologies and techniques. DeWalt furthered these claims in later work on Temascalcingo by inverting the development categories of modern and traditional — he considered an

agricultural invention indigenous to Mexico to have the greatest "modernizing" effect on Temascalcingo — going further to center the Temascalcingan agro-technology "consumers" within the technological diffusion network. This rendered them both producer and consumer of their own agricultural technological knowledge and collapsed the technological diffusion network onto Temascalcingo itself, in effect purging Green Revolution interventionists from relevancy with regard to this particular locus of innovation.

Four years prior to the publication of his "Alternative Adaptive Strategies in a Mexican Ejido," in 1975, before dispensing with the ethnocentrism of "modernization" and "development" in favor of "adaptation," DeWalt dispensed with the notions of "peasant" conservatism and homogeneity, harkening back to the anthropological debate about the inherent qualities of "peasanthood." In his "Inequalities in Wealth, Adoption of Technology, and Production in a Mexican Ejido," DeWalt emphasized the value of intra-cultural diversity to add adaptability to externally-induced technological change. DeWalt used his emphasis on campesinx heterogeneity to challenge A.T. Mosher, E. Walter Coward, Wayne A. Schutjer, V.W. Ruttan and Yujiro Hayami's insistence that socio-cultural institutional intervention was required for, and co-productive of, successful technological intervention. DeWalt vociferously critiqued the "stereotyped descriptions of peasants" that were "very poorly relatable to the realities of individual communities" and that "led to a feeling that the most important changes which need to be made are in the *values, attitudes, and motivations* of the peasant (emphasis mine)."[117] As evidenced in Benito and Moscardi & de Janvry, DeWalt believed that these stereotypes shifted the burden of the failure of agro-development programs onto the campesinxs and diverted attention away from institutional and

[117] Billie R. DeWalt, "Inequalities in Wealth, Adoption of Technology, and Production in a Mexican Ejido," *American Ethnologist* 2, no. 1 (Feb. 1975), 150.

structural culpability. More damningly, DeWalt interviewed development agents in and around Temascalcingo who told him the campesinxs were resistant to change and uncomprehending of development goals; DeWalt considered the "'scientific validation' provided in the literature for the impressions and/or prejudices of the layman" to be unfortunate.[118] Questioning the assumptions of those development agents, DeWalt found a case study demonstrating that Temascalcingan campesinxs were not resistant to change, but perhaps simply to the changes recommended by development agents unsuitable to their lifeways. They were quite eager to adopt an endogenous innovation that used local materials and local skilled labor, and that was conducive to their agricultural practices.

The story of the *sembradora* is a fine example of Mexican campesinx intra-cultural innovation. In Temascalcingo, as he had established in "Alternative Adaptive Strategies," DeWalt found variations in Temascalcingan adoption of various subsets of the Green Revolution technological package. He also found that "the most significant 'modernization' (apart from the flood control and irrigation works) in the region was not due to the introduction of Western agricultural technology. Instead it resulted from an apparently indigenous innovation of a new agricultural implement for planting corn" — the *sembradora*. The Temascalcingan campesinxs claimed the sembradora as their own invention. Although DeWalt questioned this, citing William Sanders, who had found a similar device in general use in the Teotihuancan Valley by the early 1950s. Whatever of its provenance within Mexico, the sembradora is an instance of intra-cultural diversity and innovation.[119] The most commonly used corn planting implement at the time was the *pala*, or digging stick, which functioned exactly as it sounds, and

[118] DeWalt, "Inequalities in Wealth," 151.
[119] Billie R. DeWalt, "Appropriate Technology in Rural Mexico: Antecedents and Consequences of an Indigenous Peasant Innovation," *Technology and Culture* 19, no. 1 (Jan. 1978), 39.

which the Temascalcingan campesinxs estimated required 10-18 person-days to plant one hectare of corn.[120] The agro-development agents' solution was for campesinxs to take out loans or form collectives to buy or rent tractors. The farmers who were studied had an historical reticence about forming collectives; such efforts had repeatedly failed, and at great cost to the smallholder farmers, due to fraud, corruption, and inequitable work loads and proceeds allocation.[121] Setting aside the efficacy of collectivism, the campesinxs had reservations about the superiority of the tractor for planting corn, and not because of any inherent suspicion of mechanization or nostalgia about manual labor — in 1973, 34 percent of Temascalcingan farmers rented tractors to *plow* their fields — but instead because they had tried the tractor and found it unsuitable *for planting*. Small holdings in Mexico, and especially those that were part of *ejidos*, were often irregularly-shaped discontinuous plots that made the use of the tractor cumbersome. This did not prevent them from using tractors to plow but planting required more precision and the tractors, and the planting attachments they pulled, were instead designed for larger, flatter, and more orthogonal topography (as found in the American Midwest and Great Plains). When they experimented with tractors, Temascalcingan farmers reported that they regularly had to reseed by hand anyway, increasing labor costs that, when coupled with the already prohibitive cost of tractor rental, rendered this technique unfeasible.

There were other alternatives that combined the precision control of the *pala* and the labor-saving of the tractor in use before the sembradora gained widespread

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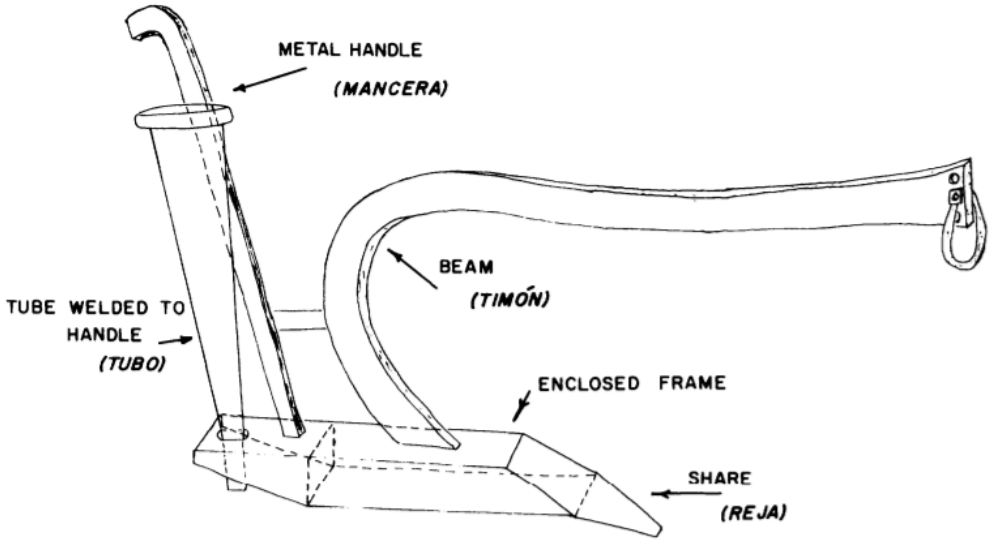
[120] Apart from the inordinate labor investment required to use the *pala*, and despite the internal scoffing of us Northerners upon reading of it, it was a technology of great adaptability and utility. It has persisted for centuries, and though it fails the Northern priority criteria of scalability and standardization, it enables farmers to drill holes to depths tailored to the moisture conditions of the soil of the individual field, and even within the field, in the hands of a farmer intimately familiar with micro-variations in slope and drainage. Its "failure" to scale and standardize is exactly its advantage — it exemplifies the agroecological approach to farming.
[121] Billie R. DeWalt, "Appropriate Technology in Rural Mexico," 44.

acceptance. One involved using a wooden plow to create a furrow, drop the seeds in, and cover the seeds with the recently excavated dirt using one's foot; the other involved creating a furrow with a steel plow, displacing the dirt to one side, dropping the seeds in and covering them by throwing the displaced dirt back into the furrow with the next pass of the plow. While these were both labor-saving relative to the pala, they failed to plant the seeds at the appropriate depth, resulting in a successful sprouting only if the spring rains came early, otherwise they planted the seed too shallowly to reach the moisture deeper in the subsoil. The innovation was to remove the moldboard (the part the pushes the churned soil off to one side), increase the angle of attack of the share (the part that knifes through the soil) to deepen the cut, and to attach a tube along the plow shaft through which a second operator deposited seeds periodically. The tube was originally constructed from the leaves of the *maguey*, a species of agave, although it was eventually formed from metal and welded to the shaft.[122]



Farmers could also adjust the depth by varying the pressure on the plow handle, "especially important when there are significant microdifferenes in soil composition

[122] Billie R. DeWalt, "Appropriate Technology in Rural Mexico," 41.

within small areas."[123] As modifications were made to switch from maguey leaves to metal tubing, enhance the durability of the frame, and alter the angle of attack of the share, Temascalcingan farmers turned to their local blacksmith to implement their trial-tested recommendations. Roughly half of DeWalt's informants began using the sembradora between 1957 and 1967; by 1973 only one of the 146 people with land rights in the village was not using the sembradora (they used a tractor). Also by 1973, that local blacksmith was manufacturing over 200 sembradoras a year, limited only by how quickly he could produce them, not by demand. He said that customers had come from more than 50 miles away to purchase the sembradora, and his only fear was that one of the large plow manufacturers in nearby Monterey would begin producing them, as he could not afford the 100,000 pesos necessary to purchase the metal stamping machine he would need to compete.

The sembradora represented for DeWalt an "appropriate technology." It used local materials, local manufacturing, was powered by renewable sources, was inexpensive to manufacture and maintain, and reduced the person-days required to plant from 10-18 to two. The lesson of the sembradora was clear to DeWalt: "[t]ransplanting Western technology to a developing country may not be the best, and certainly is not the only, road to modernization."[124] The anthropological field studies between 1975 and 1979 demonstrated an awareness of the colonialist implications of their work and the larger development enterprise they studied. They also questioned the dichotomy of "peasant" traditionalism and innovativeness, highlighted the ethnocentrism of "modernization" and "development" enterprises, and inverted ethnocentric models of peasant choice that had previously centered the locus of agency onto Northern technoscience producers and the locus of blame onto Mexican

[123] Billie R. DeWalt, "Appropriate Technology in Rural Mexico," 43.
[124] Billie R. DeWalt, "Appropriate Technology in Rural Mexico," 50-51.

campesinx consumers. Depending on their professional associations, Clawson, Hoy, Gladwin, and DeWalt also began to question not merely the methods of the Green Revolution intervention in Mexico but the development enterprise itself. This trajectory of scholarship critical of development methods and the foundational principles of the development endeavor played out simultaneously in the anthropological overviews of the Green Revolution. Detached from their commitment to ethnography and the limits of that genre, many of these anthropologists extended these critiques in radical ways.

Interpretations of the Green Revolution in Mexico: Anthropology

Some of these anthropologists, like Clawson, Hoy, and DeWalt above, were unattached to any development agency. Others, like Gladwin above, were employed by a development agency and sought to critically address the coloniality of development-oriented social science from within the development apparatus. Susan W. Almy, to take a milder example, was a development anthropologist working for the Rockefeller Foundation when she in no uncertain terms acknowledged that "[s]ocial scientists — and especially anthropologists — are typically hired by one group (or patron) to exercise their skills on another group the patron considers hostile or inferior."[125] This comes as a surprise because her article, "Anthropologists and Development Agencies" was a protracted plea to encourage more anthropologists to work in those agencies. She also made sure to point out that anthropologists were an important component of British colonial administration "during the period of expanding empire," and that "anticolonial sentiment" in the South was one of the forces driving anthropologists back to academia and away from Southern development projects.[126]

[125] Susan W. Almy, "Anthropologists and Development Agencies,"*American Anthropologist* 79, no. 2 (Jun. 1977), 286.
[126] Almy, "Anthropologists and Development Agencies," 284.

More commonly, critiques came from outside the development enterprise. Larissa Lomnitz, for her part, insisted that "[e]verywhere in Latin America anthropologists have been directly or indirectly members of the central state apparatus . . .," and she refers directly to the complex colonial situation in Mexico. Pointing to President Lazaro Cardenas's 1940 Indian Policy (which, in Cardenas's words, was "'not concerned with keeping the Indians as Indians, or with indianizing Mexico, but rather with mexicanizing the Indians'"), she observed that the colonization of Mexico's indigenous population could as likely come from their own federal government, majorly staffed with Mexicans of preponderant Spanish ancestry, or who presented as such, as it could from European or American interference.[127] She, too, connected anthropology to the intellectual lineage of colonialism, reminding us that the first ethnographers in Latin American were Spanish soldiers and priests attempting to convert the indigenous population.[128] Frank C. Miller, an anthropologist at the University of Minnesota, mincing no words and wasting no time in an article drawing on Vine Deloria added: "In distant lands we have been accused of academic imperialism: it is said that we mine the colonies for data and take the profits home, contributing nothing to the welfare of the people who have furnished that data," in order to reverse this legacy, Miller advocated for "a new willingness [by anthropologists] to examine our assymetrical [*sic*] relationship with the subjects of our research and a new determination to seek ways to redress the balance."[129]Almy, Lomnitz, and Miller did more than urge caution about the

[127] Larissa Lomnitz, "Anthropology and Development in Latin America," *Human Organization* 38, no. 3 (Fall 1979), 314. Race in Mexico is a divisive and complicated construct. Most of the country can be identified as "mestizo," that is, of mixed European (mostly Spanish) and indigenous Mexican descent; spectral differences in degree of genetic hybridity result in a kind of colorism, by which one's "Spanishness" or "Indianness" is construed with one's skin tone, however inaccurately this may play out.
[128] Lomnitz, "Anthropology and Development in Latin America," 313.
[129] Frank C. Miller, "Knowledge and Power: Anthropology, Policy Research, and the Green Revolution," *American Ethnologist* 4, no. 1 (Feb. 1977), 190-91.

colonialist implications of the anthropological endeavor in their theorizing about the relationship between anthropologists, power, and development programs.

Almy, Lomnitz, and Miller also brought these broader questions of academic colonialism to bear on the Green Revolution in Mexico. Miller bemoaned the absence of anthropological focus on the Green Revolution and to urged others to remedy it. His "Knowledge and Power: Anthropology, Policy Research, and the Green Revolution," assessed Green Revolution technologies and institutional frameworks in order to use the Green Revolution "as a vehicle for addressing some fundamental issues about the role of technology in social change and about the role of anthropologists in policy research."[130] He did so by first problematizing the 1970 Nobel Peace Prize award to Norman Borlaug, plant geneticist and head of the wheat program for Rockefeller in Mexico, and the scientific triumphalism characteristic of popular perceptions of the Green Revolution at that time. One of the euphoric promises of Green Revolution development agents, because their technologies were primarily biological and chemical rather than mechanical, was that those technologies would be neutral with regard to scale, that is, they would be just as effective on small plots for small farmers as for industrial-scale farmers. On this point, Miller, citing Keith Griffin, an economist at Oxford, argued that though the technologies were scale-neutral, their managing institutions were not: with extension agencies targeting large farmers, creditors preferencing low-risk borrowers with collateral, and synthetic input retailers marketing to those able to buy in bulk. Griffin noted that innovation will "always" favor the prosperous and secure.[131]

[130] Miller, "Knowledge and Power," 190-91.
[131] Keith Griffin, *The Political Economy of Agrarian Change: An Essay on the Green Revolution* (Cambridge, MA: Harvard University Press, 1974), 232. From Miller, 194.

Here Miller, like the economist Burke, entered into a major concern of science and technology studies. Can we extricate technology from the social causes and consequences of its implementation? Must we assume the neutrality of the technological object and ensure the equality of opportunity inherent in that object and conversely assume any inequalities must be the liability of the individuals or institutions responsible for the implementation of that technology? Is it possible that a technological object itself, or a scientific precept, be imbued with the sticky social residues of human fallibility? The social scientists I discussed in the case studies had a difficult time grappling with this possibility: they proposed alternative implementation protocols, alternative design processes for the technologies, or different combinations of technologies rather than consider that the technology itself could be accentuating socioeconomic inequality. They always blackboxed the technological object foisted on Mexican *campesinxs* and only concerned themselves with every ancillary element of technological intervention.

In his recommendations to anthropologists to study the Green Revolution, however, Miller did not shy away from the technological object, although he understood that some anthropologists, lacking technical expertise, may have felt uncomfortable and unqualified assessing such a massive technological package. What he was in essence urging was the application of ethnographic expertise to agronomic scientist and engineer working groups: an anthropology of technoscientific production that would at least begin to redress Deloria's charge of anthropological imperialism. He provided four questions for anthropologists working on the Green Revolution: "What are the intrinsic attributes of the new technology? What can it do, and how is it superior to the old? What new constraints are associated with these attributes? Who controls the

application of the technology, and for whose benefit?"[132] In Miller's scheme the technological object itself would no longer be the exclusive purview of technologists, and no longer immune from the critical gaze of anthropologists investigating a development program. For Miller, addressing these questions required a multidisciplinary effort by both agronomic scientists/technologists and social scientists. This kind of collaboration was essential to what Miller saw as the critical disjuncture between the quantitative purview of agronomists and the "merely" qualitative purview of anthropologists. Against Acheson's preference for quantifiable econometric variables, Miller, if a bit dramatically, contended that "just as quantification is not an invention of the Devil to encourage intellectual sloth, neither is it the golden road to salvation."[133] Miller recognized that, on the one hand, "[t]he ecological effects of pesticides are important whether or not they are recognized in the world-view of the local cultures. On the other hand, local people may perceive costs and benefits that are not understood by outside technicians and planners." He was arguing that costs and benefits should be understood from both an *etic* and an *emic* view (reiterating Kunkel's recommendation above), and with consideration of both quantitative and qualitative factors, making a compelling argument for the value of technoscientific and social-scientific cooperation.[134] In the same way that Green Revolution studies prefigured Schwartz Cowan's consumption junction framework from the early 1980s, Miller's 1977 proposal for an anthropology of technology mirrored the current social construvtivist fermentation in the then nascent Science and Technology Studies (STS). It would be interesting to see if Miller's suggestion that sociologists and anthropologists of

[132] Miller, "Knowledge and Power," 196.
[133] Miller, "Knowledge and Power," 196.
[134] Miller, "Knowledge and Power," 196.

technology should collaborate with engineers and other technologists was likewise considered in STS journals at that time.

Susan W. Almy devoted her "Anthropologists and Development Agencies" to that very suggestion, although with the specific condition that more anthropologists should seek not just to cooperate with agronomists, but to do so in the employ of development agencies and NGOs. At the time of its publication Almy was working as a socio-economist/anthropologist for the Rockefeller Foundation. Almy, too, saw the potential for social-scientists to work with physical scientists in technological interventions, although she believed that social-scientists were too often deployed to "modify organizational environments" — specifically the host socio-cultural and political institutions — either to facilitate the more effective use of a technology or to mollify its negative effects. What was needed instead, she argued, was for anthropologists to work with physical scientists with the goal of building their socio-cultural expertise directly into the technology or technique from the start.[135] As did Miller, Almy held that technological objects and techniques are not isolated from their social causes and consequences. It was not just institutional and campesinx targets of the technoscientific package that should be subject to social-scientist participation but the design and development of the technoscientific package itself.

Almy also brought to the fore an understandable suspicion of her anthropologist colleagues who "justify their work by the contradiction that their sciences are too imperfect for them to develop the degree of control and prediction toward which they aim."[136] In a development agency their employer would actually attempt to enact that degree of control using their "imperfect" science. Underneath this justification was the assumption of the superior epistemic status of more exact sciences. The

[135] Almy, "Anthropologists and Development Agencies," 282-83.
[136] Almy, "Anthropologists and Development Agencies," 286-87.

anthropologists' fear of being in an agency [where] "the immediate likelihood of a theory's implementation is increased, and with it a sense of contradiction and level of tension," could excuse them from cooperating with development programs. Almy's evaluation upheld the epistemic hierarchy where qualitative social science was lower in status than sciences construed as "hard" or "exact," but nonetheless introduced a destabilizing possibility: that anthropologists could act from a position of power within an operative agency, rather than from an adversarial position outside it.

Larissa Lomnitz, in her "Anthropology and Development in Latin America" had no such qualms about social scientists adopting an adversarial anthropological attitude to modernization. Rather than reform the development enterprise by recommending changes to the specifics of its implementation, Lomnitz articulated a vision of Latin American anthropology committed to a path of Latin American evolution free from Northern epistemic intervention. In 1979, she described the current state of affairs in Latin American anthropology as one in which

> [a]nthropologists themselves became critical of their involvement in modernization. The disenchantment spread to the political arena. Politicians and agency officials began complaining that social scientists were ineffectual, tended to shy away from making specific recommendations, and merely criticized the existing state of affairs without offering constructive solutions.[137]

Although she stated that "[t]he critique of Latin American anthropology became radicalized" with the passive voice, she was one of the anthropologists helping to radicalize it. Originally attempting to use the Northern epistemic mode on her study communities, she instead acquired the "internal rationality" of those whom she studied:

> The revulsion against development [by Latin American anthropologists], originating in the Marxist camp, was joined by critiques of another sort. Anthropologists were trained to gather information on other cultures through participant observation, implying close personal contact with alien ways of life. As anyone who has done fieldwork knows, the internal rationality of the studied

[137] Lomnitz, "Anthropology and Development in Latin America," 315.

> communities has a way of growing on the anthropologist, until he is no longer certain whether the changes he is supposed to promote are worthwhile. External ideological notions of development (including those justifying his presence in the village) may look increasingly irrelevant. This attitude of the anthropologist is bound to irritate his employers and those academic critics who would merely trade the present blueprint of development for a different one.[138]

The effect that the "internal rationality" of study subjects had on hers and other anthropologists' attitudes toward modernization should be read as epistemic anti-colonial resistance.

Lomnitz herself, a Chilean-Mexican anthropologist trained in Mexico, here positioned herself in direct conflict with technoscientific development, and like the anthropologists she described who had been influenced by the internal rationality of indigenous Mexico, she insisted that cultural evolution is multilineal rather than unilineal — a cosmological precept antithetical to the monolithic Northern dictum of "Development": "*industrialize!*". Lomnitz undercut this core tenet of the technoscience-facilitated capitalist worldview when she posed this question: "It now seems doubtful that we in Latin America shall ever attain the levels of industrial and technological development found in Europe, the United States or Japan. Why insist on pursuing objectives which may be unrealistic, as well as unsatisfactory in terms of our own cultures?"[139] In answer to this question she called for solutions that "are less simplistic and destructive" and that:

> presuppose a basic respect for the capability of human societies to formulate valid designs for their own survival. There are many alternative roads toward development — if 'development' is understood as a more harmonious, peaceful, and productive pattern of life in a community. By utilizing local resources, local forms of production, and local social organizations, we may tap the specific contribution of each society to the pool of human experience.[140]

Because "[p]revious models of development have been based largely on the goal of incorporating traditional populations into an industrial, consumer society," Lomnitz challenged anthropologists to "shift the emphasis of development towards autonomy, self-sufficiency, and creativity at the community level."[141] The *sembradora* planting implement DeWalt described was one such example of a self-sufficient creativity at the community level that, in Lomnitz's words, used local resources, forms of production,

[138] Lomnitz, "Anthropology and Development in Latin America," 316.
[139] Lomnitz, "Anthropology and Development in Latin America," 316.
[140] Lomnitz, "Anthropology and Development in Latin America," 316.
[141] Lomnitz, "Anthropology and Development in Latin America," 316.

and social organization. The sembradora was both developed as a reaction against the local unsuitability of an artifact of the Green Revolution intervention for planting — the tractor — and, according to Lomnitz vision for an alternative Latin American development, counteracted the Green Revolution intervention and restored campesinx Mexican agricultural epistemologies.

Lomnitz's critique was not unheard of for the exception it took to the very notion of "development" as a euphemistic metonym for Northern style industrialization. Although there were other more radical critiques, Gladwin's, Clawson's, Hoy's, and DeWalt's field studies generally reflected Miller's, Almy's, and Lomnitz's caution about the colonialist implications of development-oriented anthropology and sought to remedy the information asymmetries between anthropologists and their informants that Deloria so astutely identified.[142] Clawson's, Hoy's, Gladwin's, and DeWalt's ethnographic field studies and Almy's, Miller's, and Lomnitz's distant anthropological assessments of the Green Revolution traced a remarkable trajectory in social scientific attitudes to the Green Revolution in particular and to the development enterprise in principle. As the 1970s waned, reformist critiques of Green Revolution *methods* that could be plugged back into the next iteration of the technoscientific intervention gave way to *foundational* critiques of the imposed "modernization" of Northern technoscience, liberal-democratic government, and global capitalism.

These tripartite co-productive forces of the Rockefeller-led and Mexican government-supported American intervention in Mexican agricultural knowledge-making that economists, and some anthropologists, initially made possible became, by

[142] For more radical critiques from the anthropological perspective see: Ernest Feder, "Notes on the New Penetration of the Agricultures of Developing Countries by Industrial Nations, *Boletín de Estudios Latinoamericanos y del Caribe*, no. 16 (Jun. 1974), 67-74; and, Harry M. Cleaver, "The Contradictions of the Green Revolution," *The American Economic Review* 62, no. 1-2 (Mar. 1972), 177-186.

the end of the decade, the very object of social scientific critiques. In this way, the Green Revolution underwent an inversion from being the implementation of modernization theory *par excellence* to being an instigator and indicator of a crisis in modernization theory. Interestingly, segments of the social scientific community — mostly economists and sociologists of development — originally envisioned the Green Revolution as the model of applied modernization theory and segments of the social scientific community — mostly anthropologists in close contact with Mexican communities — eventually identified it as representative of the fundamental flaws of modernization theory. As the social scientific process played out in contact with the Green Revolution and moved closer to the consumption junction, and as social scientists studied the epistemologies of their informants from the perspective of those campesinx farmers, as Schwartz Cowan would in a few years recommend, social scientific work on Mexican agriculture was transformed from a complementary source of epistemic colonialism to a potent source of epistemic anti-colonialism.

Conclusions/Extensions

The technoscientific intervention of the Green Revolution was built upon the theoretical foundation of modernization theory developed by social scientists, itself built upon social scientific conceptions of "peasant" attitudes. Green Revolution social science — econometric and other behavioral models — were tested on the Green Revolution's technoscientific packages. The combined technoscientific and social scientific interventions constituted a sociotechnical intervention that, coupled with American Cold War pseudo-territorialization and Mexican national identity formation with which it was co-productive, constituted a development regime. This development regime worked to supplant indigenous Mexican epistemologies, homogenize Mexican

ethnolinguistic identity, and incorporate Mexico into a liberal-democratic Cold War capitalist bloc.

Models were made of campesinx microeconomic decision-making behavior, but also of the development regime in Mexico itself. Mexico was not only the place where maize and wheat cultivars were hybridized and genetically acclimatized to the target nation, but the place where the Northern epistemology and its auxiliary institutions were acclimatized to a Southern social, political, and educational culture. It was a model of epistemic colonialism, the variables of which could be tweaked for any other target nation or community, deployed, refined through social scientific analysis, and reiterated. The Green Revolution development regime in Mexico, in general, resulted in the enrichment of a small well-propertied class and the further impoverishment, labor alienation, land expropriation, and displacement of a much larger and often often ethnically indigenous class. These results, lifting the veil of technoscience's value-neutrality and political disinterest, allow historians to view the Green Revolution development regime through the stereoscopic lenses of colonial and post-colonial historical frameworks.

The development-oriented social scientists in this period also prefigured important theoretical developments in the history and sociology of technoscientific knowledge. They insisted upon the interdependent necessity of technoscientific and socio-political institutional interventions before the idiom of co-production was articulated. They also challenged the neutrality and the asocial status of the technological object and analytically enmeshed it in political and cultural networks of social relations. Finally, they refined their analyses of technological intervention over the course of the 1970s by situating their research ever closer to the consumption junction and reorienting their critical gaze, and sometimes even their ideological affiliations, to be more in line with the perspective of the consumer. But what does

"technological consumer" mean in the context of agriculture? In Schwartz Cowan's work, upon which the consumption junction methodology was built, the consumers of household appliances for heating and cooking were also the beneficiaries of the utility those technologies provided. In subsistence agriculture, the farming family is the recipient of the benefits of improvement in agricultural practices and tools, however improvement is defined by that family according to its needs and values. But the aim of the Green Revolution was the end of subsistence farming in favor of cash cropping (even if the crops were staple grains). The goal was integrate Mexican campesinx farmers into the domestic grain market, produce a surplus beyond their subsistence needs, and use the proceeds to participate in the domestic consumer marketplace. This goal was repeated at the international national scale, where Mexico hoped to become a net exporter of grain and participate in international exchange with an import/export balance advantage. In this scheme, the campesinx farmer, in this sense, is still the recipient of the utility of technological changes, but the campesinxs' conception of utility — from the value of nourishment and family provision under subsistence farming to the value consumer goods under cash cropping — must change in order to experience the utility benefits of the technological change. In this scheme, then, the technological artifact contributes to the alienation of the farmer from the products of their labor. How does this relocation of the site of consumption and the sudden reconfiguration of an artifact's utility to the farmer affect analytical approaches in the sociology and history of agricultural technology?

This thesis also closely skirts a carefully-guarded barrier in historical practice. Its primary source material is clustered up against the year 1979. One of the methodological approaches it employs was first articulated in 1983. I have suggested that, almost certainly unbeknownst to Schwartz Cowan, many of the practices she recommended to sociologists of technology arose independently out the experiences of

social scientists in the Green Revolution; I even suggest that the genesis of those approaches in Green Revolution Mexico — the inversion of the technological diffusion network, the centering of the consumer, the adoption of the consumer's gaze back over the network — was born out of an opposite attempt to understand and optimize the network according the the producer's priorities. The point here is not a silly priority claim about the rightful origins of the consumption junction methodology, but instead to examine the muddled intersection of social scientific and humanistic practice in the messy interdisciplinarity of Science and Technology Studies. The retrospective focal length historians need in order to achieve adequate distance from the subject of their inquiry can become impinged upon when they, through their cozy interdisciplinary relationship with the sociology of technoscience, borrow methodologies that were meant to be used *by* their subjects, not *on* them.

Another shortcoming of this thesis is the attention I failed to give the "artifacticity" of agricultural knowledge. This thesis is, in this sense, too much an intellectual history where it could have also and more productively been a material-cultural history of Green Revolution epistemic colonialism. Unfortunately, I, too, was inculcated in the Northern mode of knowledge production. As a knowledge-embedded material object, the hybrid seed that was recommended to Mexican campesinxs alienated them from their local cultivars' germplasm whose genetic lines they have sculpted for centuries. If knowledge is to be found in practices and objects as much as in brains, the displacement of campesinx agricultural techniques and long-husbanded genetic material constituted a knowledge erasure. With the exception of technically- and financially-intensive climate-controlled seed storage, campesinx botanical genetic heritage, unlike paper reservoirs of knowledge, must be planted and propagated or will perish; campesinx agricultural techniques likewise must be practiced to be preserved. These shortcomings in this thesis bear an ironic resemblance to the shortcomings of

the Green Revolution technoscientific packages: a program that was purported to transcend scarcity but instead replaced an agroecological system sustained over the course of centuries that used local materials with a technoscientific system with implements made from non-renewable metallic and petroleum-based materials and fueled by non-renewable fuels, using inputs the production and use of which is a significant source of air and water pollution and biodiversity reduction, and with seeds that cannot reproduce with one another.

And why do biomimetic metaphors keep cropping up? Shiva's "monoculture of the mind", DeWalt's "adaptive strategies", and De Sousa Santos *et al.*'s "ecology of knowledges". Rural farming cultures are socioecological systems. Mechanistic reductivity is inadequate to the task of describing them, and so we find ourselves turning to metaphors built from complex organic phenomena. While this thesis posits an argument, it works much harder as a prospectus for future, more rigorous work analyzing the relationships among agricultural intervention in Mexico; the co-production of technoscience and state in the Cold War; the impossibility of separating science and technology in agricultural research (or prioritizing one above the other); the conflict between the causal linearity and compartmentalization of mechanistic reduction and the messy circularity and complex interdependence of organic phenomena like agroecology and rural communities; and the erasure of the agroecological knowledge of those rural communities by Northern technoscience's claims to universality and lawful causality.

Epilogue

> "In general, though, among the *ejidatarios* themselves, corn is not seen as a viable cash crop. Repeatedly I was told by informants that '*maiz no es negocio*' ('corn is not business')."[143]

[143] Billie R. DeWalt, "Inequalities in Wealth," 162.

Edwin J. Wellhausen, a native of Fairfax, Oklahoma, was part of the original team sent by the Rockefeller Foundation to help found the Mexican Agricultural Program (MAP). He was one of the first development agents of the Green Revolution. After a decade as head of the corn breeding program, he succeeded George J. Harrar as the director of MAP. When CIMMYT was established and MAP dissolved, Wellhausen became its first Director General. In a documentary produced by CIMMYT commonly known as *Harvest*, Wellhausen had this to say about the interaction between Rockefeller agents and local farmers based on an experience he had shortly after his arrival in Mexico:

> First came down here in 1943, I thought I knew all about growing corn. I was fresh from the state of Iowa where I suppose more corn is grown than any place in the world in the same size area. I wanted to speed up things, so I went into the state of Morelos, rented some land, and started to work. And we took a tractor and other pieces of farm implements along with us to prepare the land in order to get moisture into the soil while we irrigated it. We furrowed it out and we planted our seed in these furrows. As we dropped each seed we covered each seed by shoving dirt on top of it with our feet. This left a nice loose cover of soil, left it in a condition which I thought was ideal for germinating. A number of times while we were doing this a man that did all the work around there he came by and he kept saying well you can't plant corn this way and I said what do you mean you can't plant corn this way. He says it won't grow. Well you know we waited about ten days and only one plant here and there separated by as much as 10, 20 feet appeared in the whole field that we planted. And he came back when I was looking over the field and shook his head. He said, let me show you how to plant this stuff so I said alright. I'm gonna plant the seed that I have left just exactly like you tell me how to do it. So what did he do? He got out his team of oxen. We went over to an adjacent piece of land and started to work. First thing he did was made a furrow with this old egyptian plow. Made a furrow about 3 inches 4 inches deep and about 3 inches wide, something like that. And he put the seed in that furrow. Then he came along and made another furrow right along the side of it, close enough to where as he went along, the dirt from his egyptian plow pushed over or fell over onto the seed we had planted. Now he said we'll run water down this furrow I made. Okay we planted the whole field in this fashion. Ten days later it had a perfect stand. Every grain in that field came up just as beautiful as could be. I said what's the trouble here? Why didn't my method work? I scratched around in the soil and I found that all the seeds that didn't germinate, which were 99% of them had been destroyed by insects in the area that had crawled through this loose soil, gotten to the seed as it swelled, as it began to germinate, and ate the germa. Now the method that he used prevented the insects from getting down to the seed because by irrigating after the seed was planted, the water melded down the clods and closed up all the space between the top of the soil and the seed and the insects didn't get down there and the stuff germinated and came up fine. I learned quickly that in a new area, that is, an area I knew little or nothing

about, it is better to follow the systems or methods the farmers used in that area. In other words what I'm trying to say is that in technical assistance it is very important to first learn why the farmer does what he does. Once having learned this it is possible to make very slight changes and through these very slight changes to make tremendous advances, or gains, in production.[144]

[144] Centro Internacional de Mejoramiento de Maiz y Trigo, *History of a Mexican Agriculture*. 16mm, Produced by W. Van Dyke (1971: Rockefeller Foundation), Online video, accessed April 20, 2018, https://repository.cimmyt.org/xmlui/handle/10883/16797

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