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American Indian Proverb

The frog does not
drink up
the pond in which
he lives.

Disarticulated Accumulation, Agroexport, and Ecological Crisis in Nicaragua: The Case of Cotton*

By Sean Swezey and Daniel Faber

1. Introduction

Despite the massive degradation and destruction of the environment of Latin America today, the most widely read and debated accounts of the historical process of underdevelopment neglect the ecological contradictions inherent in uneven capitalist accumulation in agriculture.[1] Dominated by capitalist enclaves of export crops, which exist in a symbiotic relationship with marginal subsistence production, the social relations characteristic of functional dualism in Latin America have resulted in dramatic episodes of environmental degradation leading to specific periods of "ecological crisis." In these crises, the degradation of capitalized land and other natural resources created environmental or social barriers to further accumulation. The intimate relationship between degradation of natural resources, the exploitation of labor, and economic crisis in the subsistence sector in Central America is described by Daniel Faber elsewhere in this issue. The intent of this article is to further the analysis of ecological factors as a source of crisis for dependent capitalist development, using a specific case study, that of

[1] A partial exception is: Alain de Janvry, *The Agrarian Question and Reformism in Latin America*. Baltimore: Johns Hopkins Press, 1981.

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cotton agroexport in Nicaragua.

One definition of "ecological crisis" is a turning point occurring in the process of capital accumulation in which the exploitation of natural resources ("capitalization of nature") results in critical and possibly irreversible degradation of natural factors necessary to production, i.e., conditions of production.[2] The effects of this degradation create an environmental or "external barrier" to further capital accumulation. Under disarticulated accumulation characteristic of the agroexport enclaves in Central America, periodic ecological crisis is a common historical feature and is intimately linked to economic problems and social disruption and struggles. It is our hypothesis that the model of disarticulated accumulation is structurally contradictory on specific *ecological* grounds which have not been generally recognized as causative factors in the economic crisis of the agroexport sector in Central America. In general, conditioning features common to ecological crisis in the agroexport platform include:

(1) The platform is a major sources of foreign exchange during the historical interval in question through the export of a primary agricultural good to the world market.

(2) The platform is dependent on the importation of foreign technology and inputs for the production of the primary export and thereby susceptible to imbalances created by price fluctuations on the world market for agroexport products and increasing prices for imported machinery and oil-based inputs.

(3) An agrarian bourgeoisie allied with multinational capital has dominant control over land resources, credit and subsidies from state banks, profits from the importation of inputs and machinery, and maintains coordinating links with a repressive military or police state apparatus.

[2] See James O'Connor's "Capitalism, Nature, Socialism" elsewhere in this issue.

(4) The onset of periodic ecological crisis is associated with rapid accumulation of agroexport profits, rapid degradation of environmental resources important to the production process, and increasing proletarianization and impoverishment of the rural population. Above all, the ecological conditioning of the crisis is *cyclical* in nature, responding to the fluctuating combination of ecological and social factors.

(5) Technical improvements and adjustments in the production process may serve to produce intervals in which external ecological barriers are momentarily overcome and which allow for continued accumulation at a reduced or modified rate.

(6) Degradation of important environmental resources or processes may become permanent and irreparable in the context of rapid reproduction cycles characteristic of agroexport, leading to collapse or retraction of production.

While other observers[3] have noted the importance of environmental factors in producing social instability in rural Latin America, we believe further theoretical discussion and case study analysis must be undertaken to elucidate the important structural relationship between ecological barriers and economic crisis in the agroexport model. The ecological crises which have historically characterized cotton agroexport in Nicaragua represent a classic example of the manner in which dependent capitalist agriculture destroys its own conditions of production, i.e., creates environmental barriers to further capital accumulation. As we shall see, the ecological crisis of cotton in Nicaragua required the adoption of new productive forces, integrated pest management (IPM), which in turn required new social relations of production, reintroduced by the revolution of 1979, to restore profitability and specific conditions of production which once existed but had been destroyed by dependent or disarticulated capitalist

[3] For example, see Robert G. Williams, *Export Agriculture and the Crisis in Central America*. Chapel Hill: University of North Carolina Press, 1986.

accumulation.

2. The Capitalization of Nature in Nicaragua

Spurred by the flow of financial capital from the U.S., intensive cotton agriculture developed in Nicaragua in the mid-twentieth century. It quickly became the new basis of the agroexport economy, displacing coffee, which had accounted for about 50 percent of agricultural exports before 1950. Cotton's area of cultivation rose from 15 to 250 thousand manzanas* between 1950 and 1973.[4] By 1971, Nicaragua was the fifteenth largest producer of cotton in the world, ranking fifth in average yield at 947 kilograms per hectare (almost twice the average production per hectare of the United States). Cotton contributed over 40 percent of the total value of Nicaraguan exports, the largest proportion of exports for this crop in any Central American economy.[5] This pattern was being repeated throughout the region as Guatemala and, to lesser degrees, El Salvador and Honduras, joined Nicaragua in the expansion of cotton production. Initially low ground rents, high fertility of the soil, and other climatic conditions; low taxes, an abundant, exploitable wage labor force, and an efficient transportation network and infrastructure; and strong political control by the cotton bourgeoisie over the state and banks translated into competitive advantages for Nicaraguan and Central American cotton producers in the world market. As a result, Central America quickly became one of the primary cotton producing regions in the world.

[4] L. A. Falcon, "Progreso del Control Integrado en Algodon de Nicaragua: Anales Primero Congreso Latinoamericano de Entomologia," *Revista Peruana Entomologia* 14(2), 1971.

[5] L. A. Falcon and R. Daxl, "Informe al Gobierno de Nicaragua sobre Control Integrado de Plagas de Algodonero," Organizacion de la Naciones Unidad para la Agricultura y la Alimentacion (FAO), Programa de las Naciones Unidas para el Desarrollo (PNUD), Managua, 1977.

* The popular units of measurement used in cotton agriculture are the manzana (0.7 hectare) and the quintal (45.36 kg or 100 lbs.).

The expansion of cotton planting involved the legal, political, and ecological displacement of small landholders, tenants, and peasants from lands on the Pacific Coast suitable for cotton cultivation. This "clearing" was accomplished by the expulsion of tenants and sharecroppers from national lands, fraudulent seizures and foreclosures of small landowners, programs of "agrarian reform," relocation of farmers to the agricultural frontier, and concentration of credit and technical aid on *latifundios* (large farms greater than 200 manzanas in size). Consequently, a large landless class of tens of thousands of rural workers was formed, functioning as a cheap labor supply for the December to March cotton harvest. Between 1952 and 1967, the cotton area expanded 400 percent while cropland dedicated to food grains (corn, beans and sorghum) by small producers in the cotton-growing area dropped over 50 percent. By the mid-1960s, cotton was cultivated on 80 percent of the total arable land of the Pacific Coast (40 percent of all cultivated land in Nicaragua).[6]

The capitalization of nature for cotton production and export not only displaced the small food producers in areas where cotton *latifundios* were established but also fostered a dependence on capital good imports necessary for cotton cultivation, in particular, insecticides. By 1965, Nicaragua was importing over 19 million kilograms of insecticide at a cost of over $10 million per year. Of these imported pesticides, 87 percent were used in cotton agriculture.[7] By the mid-1960s, Central America absorbed 40 percent of the total hemispheric export of pesticides from the United States, the world leader in pesticide production and sales. Nicaragua became the testing ground for new insecticide formulations, many of which were not approved for use in their country of origin.[8]

[6] P. Belli, "An Inquiry Concerning the Growth of Cotton Farming in Nicaragua" (Ph.D. dissertation, University of California, Berkeley, 1968); J. Wheelock, *Imperialismo y Dictadura*. Habana, 1980.

[7] Orlando Nunez, "El Somocismo y el Modelo Capitalista Agroexportadora," Departmento de Ciencias Sociales, Universidad Nacional Autonoma de Nicaragua (UNAN), 1978.

[8] M. Vaughn and G. Leon, "Pesticide Management in a Major Crop with Severe Resistance Problems," *Proceedings of the XV International Congress of Entomology* (Washington, D.C.), 1977, pp. 812-15.

At the beginning of the cotton boom, synthetic organic insecticides were considered the "miracle drugs" of the agricultural world. Growers in Nicaragua regarded methyl parathion to be the "atomic bomb for the boll weevil."[9] With the introduction of DDT and methyl parathion, the commercial cultivation of cotton over extensive areas had become technically possible. A period of sustained increase in productivity and hectares planted occurred from 1949 to 1965 due to the powerful insect-killing properties of the new insecticides. It was the "golden era" for the pesticide multinationals, which by 1968 were marketing over 75 commercial formulations in Nicaragua.[10]

But the miraculous properties of these pesticides were short-lived. The Nicaraguan cotton *latifundistas* soon became trapped on the "pesticide treadmill," a syndrome reenacted in cyclical stages in pesticide-dependent cotton cultivation throughout the world.[11] After relative prosperity in an "exploitation" phase from 1950 to 1965, cotton production passed into a "crisis" phase of falling yields and spiralling pesticide costs. Several cotton pests had become resistance to the insecticides, while populations of beneficial predators and parasites--"natural enemies" of insect pests--were devastated by the mounting insecticide applications. Populations of the cotton bollworm (*Heliothis zea*), for example, a cotton fruit-eating pest, were found to be 45 times more resistant to methyl parathion than any field population previously recorded in the scientific literature.[12] The cotton boll weevil has recently been shown to be ten times more resistant to methyl parathion than any field population previously reported in the literature.[13] By the 1965-66 season, a decade of heavy insecticide use had increased the number of economically important insect pests from five (pre-1955) to nine. Yields fell by a total of 30 percent from 1965 to 1969, at an annual rate of

[9] G. Muller and H. von Eickstadt, "Asesoramiento Fitosanitario en el Cultivo de la America Latin y del Proximo Oriente," *Planzenshutz Nachrichten Bayer* 22(1), 1969.

[10] Vaughn and Leon, *op. cit.*

[11] R. F. Smith, "Fases en el Desarrollo de Control Integrado," *Boletin Sociedad Entomologia*, Peru, 6, 1971.

[12] D. A. Wolfenberger, M. J. Lukefahr, and H. M. Graham, "A Field Population of Bollworms Resistant to Methyl Parathion," *Journal of Economic Entomology* 64, 1971.

[13] S. L. Swezey and M. Salamanca, "Response of boll weevil to methyl parathion in Nicaragua," *Journal of Economic Entomology* 80(2), 1986.

nearly 16 percent, due principally to losses from insect pests. The average yearly number of insecticide applications had risen from between five to ten in the mid-1950s, to a calendar schedule of 28 applications in the late 1960s (literally an application every 4 days). In extreme cases, some fields were being sprayed as many as 35 times a season. Insect control costs were more than 32 percent of total production costs for the year 1968.

Not only did important pests rapidly reappear to damaging levels, but previously innocuous or undetectable pests, unknown in the mid-1950s, were freed from their natural controls and now had become new secondary pests. The explosive resurgence of *H. zea*, the armyworm (*Spodoptera sunia*), and the cotton virosis vector (*Bemisia tabaci*--tobacco whitefly) became increasingly difficult to control.[14] Cotton growers responded by applying more insecticides at higher doses and shorter intervals. The "treadmill" had been put into action. The more insecticides were applied, the more they were needed to stem the tide of the ecological and economic destruction they caused.

The self-destructive nature of dependent or disarticulated capitalist accumulation for the conditions of cotton production in Nicaragua is exemplified by the pesticide treadmill. Pesticides are supposed to minimize crop losses and maximize productivity (and therefore profits) through the chemical elimination of insect pests. However, pesticide corporations also design broad spectrum chemicals, the aim of which is to maximize their market share. The broader the spectrum, the less predictable and controllable the pesticide becomes in the long term for the grower.[15] In the case of Nicaragua, the ecological/economic crisis of the cotton bourgeoisie proved to be economically beneficial for international corporations which sell pesticides because it increased their *markets* by destroying older and more favorable conditions of production. Cotton growers found themselves using greater quantities of old pesticides, as well as qualitatively new (and often more expensive pesticides) to address an ecological crisis which had been self-created. In fact, many of the insecticide companies also sell seed varieties which are heavily pesticide dependent. Not unlike a dealer pushing heroin to

[14] Vaughan and Leon, *op. cit.*

[15] Richard Levins and Richard Lewontin, *The Dialectical Biologist*, Cambridge: Harvard University Press, 1985.

strung-out addicts in need of "more" and "better" drugs to get the same high, chemical companies push dependency-creating capitalist technologies which threaten the health and well-being of both cotton growers and wage labor. However, the ecological crisis is very precarious for international capital as well. Like the heroin junkie, pesticide "users" may "die," reducing demand for pesticides. This is the case for much of Central American cotton today, with production down over 50 percent region-wide. In the late 1960s, more than 30 percent of the foreign exchange earned from cotton exports was being spent importing pesticides and the energy for their application, while at the same time Nicaragua was forced to import the basic foodstuffs displaced by cotton agriculture.

3. The Social Costs of Cotton

The pesticide treadmill had an impact far beyond the escalating economic crisis in Nicaraguan cotton production. There are other social costs, or externalities of production. The contamination of the environment with pesticides was reaching alarming proportions. DDT and other chlorinated hydrocarbon insecticides are extremely persistent, and their low polarity (insolubility in water) ensures their concentration and slow excretion from the fat tissues of animals (and humans) which consume at the higher trophic levels of ecosystems.

Drifting of pesticide applications away from intended targets also caused destruction of natural enemy populations[16] and secondary pest outbreaks in nearby corn and bean crops, thus ecologically excluding their successful cultivation in cotton growing areas.[17] Dangerous levels

[16] G. D. Peterson, "The Quiet Crisis in Nicaragua," ms. on file, USAID-CIPP Project Library, Berkeley, CA, 1969;
C. D. Peterson, J. Sequeira, and F. Estada, "Principios y Problemas de Control Integrada de Plagas del Algodon en Nicaragua." Ministerio de Agricultura y Ganaderia, Programa de Control Integrado de Plagas, Managua, Nicaragua, 1969.

[17] A. Van Huis, "Integrated Pest Management in the Small Farmer's Maize Crop in Nicaragua." Mededelingen Landbouwhogeschool Wageningen, Nederland, 81(6), 1981. See also L. Lacayo, "Especies parasiticas de *Spodoptera frugiperda, Diatraea lineolata, Trichoplusia ni* en la zona de Managua, Esteli, y Masatepe," Monografia, UNAN-Leon, 1976.

of these chemicals have entered the food chain and work environment, contaminating not only livestock but also workers, and surrounding communities. Studies have shown average residues of 2.29 parts per million (ppm) of DDT and matabolites (maximum over 5 ppm) were detected in human milk fat samples taken from women living in agricultural regions of Leon Department.[18] Other chlorinated insecticides, including lindane and aldrin, were also found in trace amounts. According to World Health Organization (WHO) standards, women's milk in these samples was 42 to 45 times more contaminated than the "safe" level. During the mid-1970s few populations in the world had levels of DDT as high as the residents of the Central American cotton region.[19] As recently as 1980, human tissues in Nicaragua still showed one of the world's highest burdens of DDT--97 ppm, sixteen times the global average of 6 ppm.[20] The potential health hazards of this accumulation can be appreciated when one realizes that 19 of the 25 most commonly used organochlorines are carcinogenic in laboratory tests on animals.[21] During the 1970s, Nicaragua led Central America in the volume of pesticides applied, largely due to the country's heavy reliance on the less-expensive organochlorines. In the 1974-75 cotton season, Nicaragua used 19 ½ million pounds of pesticides, of which nearly 15 million pounds were organochlorines.[22]

An estimated 80 percent of Central America's acute pesticide poisonings result from organophosphate exposure.[23] Organophosphates like methyl parathion are extremely toxic in even small doses. In small doses, and often by dermal exposure only, the organophosphates are

[18] A. C. Delgado, "Determinicion de Pesticidas Clorinados en Leche Matema del Departmento de Leon." Monografia, Depto. de Biologia, Facultad de Ciencias y Letras, Universidad Nacional Autonoma de Nicaragua, Leon, 1978.

[19] Instituto Centroamericanode Investigacion y Tecnologia Industrial (ICAITI), "An Environmental and Economic Study of the Consequences of Pesticide Use in Central American Cotton Production, Final Report." Guatemala, City, Guatemala, 1977.

[20] Sociedad Aleman de Cooperacion Tecnica (GTZ), "Reporte de Laboratorio Ecotoxicologico del GTZ, DGTA." MIDINRA (Managua, Nicaragua), 1980.

[21] S. S. Epstein, *The Politics of Cancer*. New York: Anchor Books, 1979.

[22] ICAITI, *op. cit.*

[23] L. A. Falcon and R. Smith, "Guidelines for Integrated Control of Cotton Pests." Food and Agriculture Organization of the United Nations (FAO) (Rome), 1973.

acutely poisonous to the human central nervous system. During the years 1962-1972, more than three thousand acute pesticide poisonings occurred annually among Nicaraguan farmworkers.[24] This represented an annual rate of 176 per 100,000 population, nearly eight times the U.S. per capita rate.[25] In the span of two decades, Nicaragua achieved the dubious distinction of being among the world leaders in per capita pesticide poisoning. Data recorded in the early 1970s indicated that Nicaragua ranked second only to Honduras in per capita pesticide-related deaths recorded in Central America.[26]

Health hazards were increased by cotton worker illiteracy and unfamiliarity with the hazards of insecticides. Close proximity of workers' housing to treated fields, and contamination of food and drinking water also contributed to pesticide exposure among the rural population. One study of aerial pesticide application in Central America found that 10 percent of the total volume of DDT applied to cotton fell within a 100-meter area just outside the boundaries of the targeted fields.[27] The same study estimated that a minimum of 80 percent of the cotton workers lived within 100 meters of the fields in which they worked, suggesting significant pesticide exposure for farmworkers and their families beyond that encountered directly in working with pesticides and in pesticide-treated fields.

The variety of pesticide problems to be found in Nicaragua by the 1970s left little doubt that they were a major source of health problems and hazards in the rural population. In 1977, a United Nations report estimated that insecticide-caused environmental and social damage had a total yearly economic cost of $200 million, while foreign exchange earned for cotton amounted to a maximum $141 million in 1973.[28]

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[24] Food and Agriculture Organization of the United Nations (FAO), "The Development of Integrated Pest Control in Agriculture: Formulation of a Co-operative Global Programme," 1975; Report on Ad Hoc Session, October 15-25, 1974, Appendix B (Rome).

[25] D. Pimentel, D. Andow, D. Gallahan, I. Schreiner, T. E. Thompson, R. Dyson-Hudson, S. N. Jacobson, M. A. Irish, S. F. Kroop, A. M. Moss, M. D. Shepard, B. G. Vinzant. "Pesticides: Environmental and Social Costs." In D. Pimentel & J. H. Perkins (Eds.) *Pest Control: Cultural and Environmental Aspects.* Boulder: Westview Press, 1981.

[26] ICAITI, *op. cit.*

[27] ICAITI, *op. cit.*

[28] Falcon and Daxl, *op. cit.*

In the face of ecological crisis and the declining availability of foreign exchange, the Ministry of Agriculture beginning in the late 1960s sought international support for a technical solution to the treadmill dilemma: a new and more "healthy" productive force in the form of integrated pest management (IPM). The IPM philosophy makes maximum use of naturally occurring insect controls, using biological, environmental, cultural, and legal methods in a complementary fashion. IPM holds the use of chemical tools to a minimum, and when pesticides are used, they are applied only when indicated by a careful survey of the insect populations in the field under consideration. Insect populations are continuously monitored, and control measures taken based on specifically calculated economic thresholds or levels of damage, rather than mere pest presence or calendar date. The production/input ratio is maximized within the ecological and social constraints of the environment.

A program funded by the Food and Agriculture Organization of the United Nations (FAO) through the United Nations Development Program (UNDP) initiated experimental design and direct application of IPM to the field problems confronting the Nicaraguan growers.[29] The objectives of the FAO program were to reduce production costs and increase cotton revenues through the reduction of excessive use of insecticides and, at the same time, minimize the undesirable side effects of insect resistance and pesticide residues. Field plot investigations were established in 1971. Through recommendations designed to reduce gross overuse lacking any economic rationale, the IPM programs immediately reduced pesticide use by 25 to 50 percent in the test plots.[30] Through a reorganization of the labor process, this research effort was staffed and carried out by Nicaraguan biologists and field technicians. The basic IPM program did not require new technological inputs or advanced training. It was, rather, a reorientation of agronomic and pesticide-use practices which had no economic rationale, as well as the introduction of innovative techniques established through research.

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[29] A. Sequeira, "Historia de Control de Plagas del Cultivo del Algodonero en Nicaragua." *Enagronomia* 1(1), 1975.

[30] G. Leon and M. Vaughn, "Demonstracion de Control Integrado de Plagas de Algodon." Cuarto Seminario Tecnico sobre el Cultivo del Algodonero, Banco Nacional de Nicaragua, Managua, Nicaragua, 1972; ICAITI, *op. cit.*

In the 1970-71 season, applications on commercial hectarage declined to an average of 21.7 per season (range 14 to 30). With favorable rainfall in the 1971-72 cotton season, Nicaragua attained its highest seed cotton yield on record (2,707 kg/ha or 41.6 quintales per manzana) with the lowest insecticide expenditure per bale produced since the Ministry of Agriculture had kept records on pesticide use.[31] The trend of reduced pesticide use in cotton continued to a low of 19.2 applications per season nationally in the 1974-75 season, and the National Cotton Commission cited the increasingly widespread use of integrated control techniques as the major factor.[32] According to the Commission, an historic transition had been made to the integrated system of field scouting and evaluation before insecticide applications were made, rather than applications scheduled by the calendar.[33] Perhaps most significantly, an extension of the funding of the FAO project in 1974 supported the investigations which led to the publication of the first nationally distributed guides to integrated control in food crops (corn and beans) in Nicaragua, an important step in developing rational plant protection in crops for domestic consumption.[34]

These programs firmly set in place the IPM philosophy, especially among large cotton growers who quickly grasped the profit implications of these techniques. Increased profits in IPM plots (compared to conventional control plots) ranged from $3.40 to $18.48 more per manzana due to reduced insecticide costs and increased yields.[35] Due to these demonstrated advances, Nicaragua was recognized internationally as a success in the development of IPM programs. While Nicaragua reduced its overall pesticide consumption in cotton by approximately one-third (to approximately 44 kilograms/hectare in 1972), El Salvador and Guatemala, which had no equivalent national IPM program,

[31] Falcon and Daxl, *op. cit.*

[32] Comision Nacional de Algodon, "Formas y Numero de Aplicaciones Estratificadas de Insteccicidas por Manzana, Cosechas 1971-72/1974-75." Seccion de Estudios Economicos, Managua, Nicaragua, 1975.

[33] Falcon and Smith, *op. cit.*

[34] Proyecto Control Integrado de Plagas INTA-FAO-PNUD, Guia de Control Integrado de Plagas en Frijol, Managua, Nicaragua, 1978; Guia de Control Integrado de Plagas en Maiz y sorgo, Managua, Nicaragua, 1979.

[35] ICAITI, *op. cit.*

increased their pesticide use by the same amount during the first half of the 1970s, reaching 72 and 75 kilograms/hectare respectively by 1974.[36] The adoption of IPM allowed growers to receive a significant profit over competitors who did not adopt IPM.

4. The Collapse of IPM

In the 1972-73 crop season, a severe drought started a period of five mostly dry, comparatively low-production years (especially 1972, 1974, 1976, and 1977). Drought-induced explosions of the cotton leaf-miner, *Bucculatrix thurburiella*, and an outbreak of the tobacco whitefly, *Bemisia tabaci*, and *Heliothis zea*, led to increasing pesticide use, particularly of the newly introduced and far more expensive synthetic pyrethroids. During these same five years, international petrochemical prices increased nearly threefold. Insecticide prices increased by 130 percent in Nicaragua between 1972 and 1975.[37] By 1976, insecticide imports totaled $25.8 million, over double pre-IPM levels of expenditure, although the number of applications per season had remained fairly constant, rising slowly to a mean of 21 in 1976. More ominous was the instability of international prices for Nicaraguan cotton, which were depressed from late 1973-75, falling more than 27 percent from prices obtained in early 1973.[38]

IPM specialists considered the slowing of the trend of pesticide use reductions to be a retrogression of IPM philosophy. The implementation of integrated techniques, it was thought, would have continued to reduce the number of applications, not only as a result of the reduction of unwarranted applications, but also because of the implementation of alternative pest management techniques, such as biological control of secondary pests and trap-crop management of the boll weevil, which had

[36] *Ibid.*

[37] P. F. Warnken, "Impact of Rising Energy Costs on Traditional and Energy-Intensive Crop Production: The Case of Nicaragua." *Canadian Journal of Agricultural Economics.* 24(2), 1976.

[38] Nunez, *op. cit.*

returned as a key cotton pest. However, cotton hectarage was beginning a six-year expansion, reaching a peak of 310 thousand manzanas planted in 1977, nearly twice the area planted in 1971. This increase, one-half of which occurred in 1971 and 1972 alone because of the high yields in the 1971-72 season, was too great for the coordinated response of the IPM program. No institutional basis existed for the funding, training, and mobilization of skilled labor power in coordination with the expansion of cotton acreage. As a result of the unwillingness of cotton growers to adequately fund the program, and direct manipulation and intrusion by pesticide companies, the IPM program collapsed.

Nicaraguan specialists offered the following socioeconomic analysis for the lack of progress in IPM.[39] Cotton producers did not offer salaries commensurate with the training of IPM technicians who were forced to supervise more hectarage than could be adequately monitored by one specialist.[40] The increased workload often caused technicians to make poor judgments on the need for an insecticide application. Increased concentrations of more toxic materials or more frequent broad-scale applications were commonly made in order to minimize overall risks on larger hectarage.

Moreover, up to half of the pest control decisions of IPM technicians were countermanded by the farm owner under the pressure and misinformation of chemical company advertising and field salesmen. Commissioned salesmen often recommended insecticide products which had not been adequately tested under Nicaraguan conditions or had received statistically questionable approval at the Cotton Experimental Center. Evaluation of annual research reports for the mid- and late 1970's indicated that the center experimentally approved the majority of compounds presented by the chemical companies for use on cotton, regardless of whether or not the new chemicals had given significantly better crop protection.

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[39] G. Leon, "El Papel de Educacion en Control Integrado." Seminario Regional Sobre el Uso y Manejo de Plaguicidas en Centroamerica, Guatemala City, Guatemala, 26-30 de junio, 1978.

[40] A. Gomez and G. Leon, "Comparacion de Manejo y Costos de Tres Zonas Algodoneras de Nicaragua." VI Seminario Technico sobre el Cultivo del Algodonero, Banco Nacional de Nicaragua, Managua, 1977.

Two international studies also called attention to the beginning of a "decomposition" phase of the IPM movement in Nicaragua. An area-wide study of the impact of pesticides on cotton production in Central America was made by the Instituto Centro Americano de Investigacion y Technologia Industrial (ICAITI). This study concluded that pesticide use in Nicaragua was 38 percent above optimum and that further reductions could be made by refinement in pest control practices.[41] In 1977, a FAO mission to Nicaragua requested an economic evaluation of pest control practices in the country. An analysis of the 1977-78 cotton season concluded that, while recommendations by IPM technicians achieved significantly more profitable results (23 percent less pesticide use and 30 percent greater yield per unit input of insecticide) when compared to the general average, overall insecticide use had jumped from 1971-72 levels of 44 kg/ha to 78.9 kg/ha (22 applications per season and higher doses per application) in the 1977-78 season.[42]

Managing an average of more than one thousand hectares each, beleaguered integrated pest managers reported they made up to 20 percent of their applications out of nervousness or fear of unknown "risks" of pest damage.[43] Many personnel were lost to international pest control positions and commercial sales. In their peak season of 1976-77, the National Development Bank IPM programs could only cover 20 percent of the entire cotton area.[44]

Facing disorganization of services, lack of replacement parts for machinery in later years (owner decapitalization was increasing), and chronic shortage of trained workers, cotton growers sought to avoid failures by more frequent and heavier insecticide applications. Cash bonuses paid to growers by the National Bank for yields above a set minimum motivated cotton growers to overtreat in an effort to ensure

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[41] ICAITI, *op. cit.*

[42] Comision Nacionalde Algodon, "Costos de Produccion del Algodon en Nicaragua." Managua, Nicaragua, 1978-79; E. Villagran, "An Evaluation of Integrated Pest Control Efforts in Central America and a Management Strategy to Optimize Future Programs." 10th Session of the FAO/UNEP Panel of Experts on Integrated Pest Control, Rome, Ecotecnica Consultores Asociados, Guatemala, 1981.

[43] *Ibid.*

[44] Gomez and Leon, *op. cit.*

maximum yields as a buffer against net losses due to uncontrollable pests or unforeseen weather patterns. Pecticide use often reached costs well beyond the point of maximum incremental return per unit input of insecticide. Cotton production was structurally and, as we have seen, ecologically addicted to insecticides. Withdrawal would have resulted in complete failure of the agroexport platform.

The faltering philosophy of this cotton production system was fueling the deeper tensions in Nicaraguan society, which the Somoza regime was finding increasingly difficult to manage.[45] By 1977, 52 percent of all cotton lands were concentrated in the hands of 6.3 percent of all producers, and an estimated two hundred fifty families who owned a minimum of 200 manzanas or more. This concentration of wealth was increasingly financed by state banks and the U.S. Agency for International Development (USAID), which from 1968 to 1974 granted multi-million-dollar loans to the Nicaraguan government for pesticide imports. The national cotton harvests of 1977 and 1978 produced net deficits; production costs exceeded export revenues, according to production reports by the Central Bank and figures cited by the Ministry of Foreign Commerce. A tendency toward public debt financing of the agroexport economy may have been profitable for banks of the First World, but it contributed to a declared public debt of over $600 million in 1977. Debt service alone in 1977 reached approximately $70 million paid to private banks, mostly in the United states.[46]

The need to generate ever-increasing amounts of foreign exchange to pay this debt allowed the cotton pesticide treadmill to grind on, locking the economy into debt financing of maximum yields rather than promoting rational profit and reduced insecticide use advocated by IPM specialists. Some of the more prosperous cotton families also held major financial interests in pesticide-distributing firms and had even bought the rights to registered trademarks or formulations, or built infrastructure such as landing strips and warehouses to provide aerial spray services. The Central Bank also allowed largely duty-free importation of pesticides as a subsidy to the pesticide multinationals. At the same time that national IPM advisory programs were attempting to reduce

[45] Nunez, *op. cit.*

[46] *Ibid.*

insecticide use, bank loans increasingly were used to guarantee the availability of imported pesticide inputs to the concentrated group of producers who qualified for such loans. Finally, the degree of development of "unhealthy" productive forces ensured their inflexibility toward less chemical-intensive methods.

5. Revolutionizing the Forces of Production

During the decade of the 1970s, the social tensions between Somoza and the popular opposition in Nicaragua escalated, culminating in the insurrection in 1979 which deposed the dictator in mid-July. The insurrection left 50,000 dead and agricultural and industrial production in shambles. United Nations estimates placed material damages at $480 million during the conflict, not including lost wages, sales, and the disruption of continued economic activity. Cotton production was indicative of the state of the Nicaraguan economy. During the last year of the war, 70 percent of the cotton production area went unplanted, and cotton yields slumped to a twenty-year low.

The new Nicaraguan Government of National Reconstruction (GNR) initiated a variety of reforms, including an array of policies and programs to address Nicaragua's pesticide problems. IPM became a crucial component of a more sophisticated environmental program, initially one of the most comprehensive in Latin America. Some government officials recognized that the process of social transformation required environmental protection and the reconstruction of nature. In fact, IPM became one of the key efforts aimed at boosting cotton production while minimizing its social and environmental costs. The focus of GNR efforts to solve the pesticide problems through the introduction of new, more healthy productive forces and work relations can be divided into two separate but related goals: a long-term reduction in the use of expensive and highly toxic pesticides; and the immediate or short-term reduction of the human poisonings and environmental contamination caused by their excessive and careless application. Both the economic and the worker and public health gains would be considerable if these goals could be achieved. The numerous actions which the Nicaraguan government has taken to meet each of these two goals have already been discussed.[47] We here discuss the rapid

[47] Sean L. Swezey, D. L. Murray, and R. G. Daxl, "Nicaragua's Revolution in Pesticide

reskilling of rural workers and mass implementation of IPM practices which occurred in 1982-84. It has been this effort that generated some of the most striking gains since 1979.

Reduction in pesticide use has been concentrated around the consolidation of the IPM programs in the cotton region. The use of insecticide inputs to produce cotton in the first normal season of cotton production (1981-82) reverted from a "decomposition" phase to a one-year ecological crisis. An average of 27 pesticide applications (maximum over 40) were made in the cotton-growing region of Leon during the 1981-82 season, when the cotton boll weevil appeared in densities never seen before. The outbreak had been induced by a shortage of agricultural machinery which resulted in a delayed harvest and poorly coordinated crop-waste destruction programs, essential to integrated control in cotton. Yields in Leon fell to 30 quintales per manzana in spite of heavy chemical treatment. Chemical control of the boll weevil cost $150 per manzana ($19.5 million on the total of 130,000 manzanas) and the boll weevil still destroyed 20 percent of the potential harvest.

With an added loss of $3.2 million in cottonseed oil which could have been produced from this seed cotton, foreign exchange losses to the boll weevil amounted to $42 million,[48] or 16 percent of the total foreign exchange earnings in agriculture for that year. The cost of pesticides applied to cotton exceeded 26 percent of total production costs (as high as $450 per manzana) and in Leon, average yields were not enough to pay for expanded production expenses.

In 1982, the National Committee on Integrated Control, an advisory panel of Nicaraguan IPM specialists, was formed. It began by recommending area-wide cotton pest management programs, based in part on the IPM successes of the early 1970s. Essential to the success of cotton pest management is early, between-season control of the cotton boll weevil, the key pest, to avoid population carry-over in cotton stalks during the summer between commercial crops. Nationwide crop residue destruction laws prescribe fines for producers who do not comply with

Policy." *Environment* 28(1), 1986.

[48] I. Gallo and R. Daxl, "Proyecto Piloto Supresion de Picudo Entre Temporadas Algodoneras." *Propuesta*, Leon, Nicaragua, 1982.

fixed dates for cutting and plowing under the cotton stalks. In addition, regional programs now also direct a system of small, post-harvest "trap crops" (four rows by 50 meters) of cotton stalks, at a density of approximately one trap crop per manzana, in which to attract and destroy the boll weevil by daily insecticide application. After the first rains in May, new traps are planted adjacent to the stalks and treated with insecticide until the commercial crop (planted in June and July) sets fruit in September. Early population buildup of the boll weevil is thus suppressed, saving future insecticide applications.[49]

The boll weevil program is followed by dense seeding to obtain a high plant population resistant to damage by soil pests, and scouting at three- to four-day intervals by trained field aides to monitor the growth and development of the cotton plants and determine the status of pests and activity of natural enemies. Management decisions are based on this information. These integrated techniques (especially trap-cropping) require area-wide implementation for success because key pests are widely distributed and highly mobile over the cotton-growing area. It is therefore necessary to organize regional programs involving all producers on private or state farms. Capitalist property relations constituted a major stumbling block to such planning before the revolution. However, the revolution allowed the government to more rationally plan production and mobilize labor on a mass scale.

Government implementation of regional IPM programs began early in 1982, when the Ministry of Agriculture (MIDINRA) approved a 24,000-manzana pilot trap-crop program designed to suppress the boll weevil on more than half the cotton area of Leon--the largest single-season mobilization of private and public resources for IPM in cotton ever undertaken in Nicaragua. The program trained two hundred and fifty farmworker-scouts to supervise the management of 5,000 trap crops throughout the suppression area and relied on a network of several hundred trained workers to survey and control the boll weevil in the fields. The mobilization and involvement of labor in production

[49] Comite de Control Integrado de Plagas del Algodonero (CIIPA), Manual de Manejo Integrado de Plagas del Algodonero de Asistencia Tecnica, Managua, Nicaragua, 1979; R. Daxl and R. Bodan, "Cultivos Trampas como Elementos Claves en el Control Integrado del Picudo, *Anthonomus gradis* Boh." VI Seminario Tecnico algodonero, Banco Nacional de Nicaragua, Managua, 1977.

decisions is something that it is hard to imagine happening in the pre-revolutionary regime, but absolutely critical to the success of IPM.

The combination of large-scale boll weevil suppression and the ensuing commercial IPM program within the zone delayed the first broadcast application of insecticides to Leon cotton fields an average four weeks compared with nontrapped controls within the same climatic zone. The suppressed population buildup of boll weevils saved up to eight pesticide applications against the weevil in the trap-cropped area.

Overall, the 1982 program saved a net $2 million in insecticide usage. Apart from higher profits, this saving meant less dollar outflow and dependence on multinational pesticide producers. The 1982-83 year was a record post-triumph production year, producing over 39 quintales per manzana on the national level, with profits of over 1,9000 cordobas per manzana, the highest profits ever recorded under the IPM programs. Deducting the program's cost of $45.97/hectare, an overall net benefit of $2.02 million resulted, a 139 percent return on invested capital per hectare.[50] In view of the success of these techniques, the government expanded the suppression project to 48,000 manzanas in 1983 and issued Degree No. 1226 of April 6, 1983, making obligatory to all cotton producers the between-season boll-weevil suppression. The 1983 efforts resulted in a net benefit of over $1.9 million from reduced pesticide use. In 1984, the program was the largest such enterprise in Central America, and quite possibly in Latin America.

6. Conclusion

IPM could prove integral to the Nicaraguan government's effort to restructure the conditions, forces, and social relations of production along a politically non-aligned, rationally planned development path.

[50] Centro Experimental de Algodon (CEA), "Proyecto Piloto Supresion de Picudo, Informe Final de la Temporada 1982-1983." MIDINRA, 1983. For 1983-84 season data, see CEA/UNAN, "Evaluacion del Programa Control de Picudo," Nicaragua, 1984. For an English language report, see S. Swezey and R. Daxl, "Area-wide suppression of boll weevil populations in Nicaragua." *Crop Protection* 7(3), 1988.

Unlike the dependency created by pesticides, IPM and other biological controls are "independent" productive forces which can be produced within the country at relatively low costs, require low inputs, and are safer for workers and their communities. In this sense, IPM could prove instrumental to the national security and ecological integrity of the country. Just as capitalist agriculture required technical innovation, or new productive forces, in the form of pesticides to overcome specific barriers to capital accumulation during the 1960s, new productive forces in the form of IPM are needed in the 1980s to break dependency and facilitate the process of socialist reconstruction through the production of export crops in a safe but profitable manner. Continuing training of Nicaraguan specialists in the philosophy and tools of IPM and organized social implementation of the programs are central to the continued success of these programs and the creation of a popular base for the reduction of Nicaraguan dependence on imported pesticides. IPM can also help alleviate the tension between export-oriented agriculture and food crop production for national consumption. By means of reduced pesticide use and stronger reliance on biological crop protection, profitable cultivation of basic grain crops such as corn and beans will be feasible again on the fertile soils of the cotton areas. Under MIDINRA plans, a more intensive utilization of the cotton fields for national food production has been initiated.

The Nicaraguan revolution has provided new opportunities for the development of healthy production forces and a more rational organization of agricultural production. However, Nicaragua has been and remains confronted by political and military aggression from the U.S., which is bent on reversing the changes being implemented by the fledgling revolution and making the Sandinistas submit to its will. A financial blockade and the subsequent trade embargo imposed by the Reagan administration in May 1985 have been primary sources of the economic problems.[51] The blockade has included a cutoff of bilateral aid, opposition to Nicaraguan loan applications to multilateral lending institutions, and pressure on commercial banks and other countries to stop lending to Nicaragua. The trade embargo has heightened the problem by cutting off access to an array of goods and replacement parts

[51] R. Shoulk, "U. S. Economic Aggression Against Nicaragua." Paper presented at the XI International Congress of the Latin American Studies Association, Mexico City, September 29 to October 1, 1983.

in the agricultural sector. These actions have had serious consequences for Nicaragua's efforts to pursue reconstruction and finance new social programs. Coupled with the damage inflicted by the *contra* war, severe obstacles to pesticide and other policy reforms have been created. The ability to devote resources to social problems, to conduct research, planning, training, or implementation of social policy, has been undermined by the costly defense of the new revolution's borders.

The *contra* attacks have had a major impact on the Nicaraguan productive sector. This impact has been particularly acute as the attacks have shifted focus from military objectives to the disruption of production and the delivery of state agricultural services to rural areas. The increased incursions of the *contra* had a serious impact on the day-to-day functioning of the social reforms as well. With the escalation of the aggression, the government sought to augment the army and local militia defense forces through a reliance upon "mobilizations," or the use of temporary volunteers for defense and production activities.

Those mobilizations have generated serious problems for Nicaragua's long-term development. Those mobilized are often the very people being trained as fieldworkers, technicians, and policy-makers and implementers. The National Boll Weevil Control Program experienced major problems of labor availability and materials acquisition during 1984, its largest implementation year. The project was largely abandoned from 1985-87 and was only recently reorganized in limited fashion for the 1987-88 season.

In summary, U. S. imperialism is undermining the development of more healthy productive forces and economic vitality in Nicaragua. Since 1984, cotton yields have fallen from 34.5 quintales per manzana to 26.9 quintales per manzana (1986) and only 85,000 manzanas of cotton were planted in the season ending in 1987, the smallest area planted since 1979. The decline of cotton agriculture in Nicaragua is associated with the inability to continue importing costly insecticides and the difficulties of continuing mass-based pesticide reduction programs in the war economy. The past ecological disruption of cotton agroecosystems is now one major barrier to healthy production in cotton agroexport; imperialist aggression against Nicaragua and the resulting deterioration of the national economy is the other.

The Last Stand: Social Democratic Discourse of Crisis

By David Peerla

1. The Economic Context

The prevalence of "theories" and "crises" inevitably leads to a debasement of meaning of these terms. The proliferation of theory in the social sciences creates an aura of coming crises in which hoped for unified discourses seem ever more distant. Paradigms become the scenes of internecine warfare rather than the paragons of normal science. It is even unclear to some writers whether or not Marxism shares enough central propositions to be a meaningful analytic category.

Within this context, one is understandably hesitant to offer yet another crisis for consideration. Be that as it may, my research considers the crisis in Ontario's forest industry, but, with one essential difference. The paper is sub-titled "Social Democratic Discourse of Crisis." The word "discourse" suggests a movement to and fro. The meaning of the forestry crisis was constructed in the to and fro struggle between the major actors: the pulp and paper corporations, federal and provincial governments, political parties, workers, environmentalists, and communities. Two questions animate my discussion. How was the meaning of the forestry crisis created by the social democratic opposition party, the New Democratic Party (NDP), in this agonistic struggle? And, what are the political implications of the NDP's representation of the crisis? It is my contention that the NDP's move from a global narrative of forest crisis toward a story of local or site specific crisis is an allegory of the dilemma which faces all who attempt to think globally and act locally.