J. Lat. Amer. Stud. **40**, 399–421 © 2008 Cambridge University Press
doi:10.1017/S0022216X08004380 Printed in the United Kingdom

Eradication Efforts, the State, Displacement and Poverty: Explaining Coca Cultivation in Colombia during Plan Colombia*

MICHELLE L. DION *and* CATHERINE RUSSLER

Abstract. This study models the sub-national pattern of coca cultivation in Colombia following the implementation of Plan Colombia (2001–2005). The results suggest that aerial eradication reduces coca cultivation primarily through creation of significant displacement and that coca cultivation is less intense in areas with a significant state presence. Further, coca cultivation appears to be more common in less developed, agricultural regions where access to legal markets precludes other forms of agriculture. Poverty has a significant, non-linear effect on coca cultivation; cultivation is most intense in regions of moderate poverty. Based on the findings, efforts to reduce coca cultivation should emphasise developing local public infrastructure and market access in conjunction with poverty reduction efforts and investment in alternative development.

Keywords: Colombia, coca cultivation, aerial eradication, poverty, public infrastructure, market access, Plan Colombia

Introduction

Coca production begins in the valleys and upper jungle regions of the Andean region, where the countries of Colombia, Peru and Bolivia are host to more than 98 per cent of the global land area planted with coca.[1] During the 1990s, Colombia rapidly overtook its neighbours and became the region's leading coca producer – while in 1994 the country accounted for 22 per cent of total regional cultivation, by 1990 that figure had risen to

Michelle Dion is Assistant Professor of International Affairs at the Georgia Institute of Technology, Atlanta, GA 30332-0610. (404) 385-4081. Fax: (404) 894-1900. Email: mdion@gatech.edu.
Catherine Russler earned an M.S. in International Affairs at the Georgia Institute of Technology, Atlanta, GA 30332-0610. Email: caterus@gmail.com

* The authors thank the JLAS editors and anonymous reviewers for constructive suggestions for improving this article.

[1] Rocio Moreno-Sanchez, et al., 'An Econometric Analysis of Coca Eradication Policy in Colombia', *World Development*, vol. 31, no. 2 (2003), pp. 375–83.

73 per cent.[2] This Colombian expansion coincided with the implementation of aggressive coca eradication and interdiction campaigns in Bolivia and Peru, backed by the USA, as well as the dismantling of the Colombian cartels that imported Andean coca for production and export from Colombia. Despite aggressive interdiction and eradication measures within Colombia, myriad smaller cartels and the cultivation of coca have since proliferated in its countryside.[3] The United States government views the illicit drug industry as a national welfare threat and allocates enormous resources to its destruction. The USA has accordingly provided Colombia with well over US$4 billion since 1999 in order to combat the production of coca, cocaine's primary ingredient. The rationale underlying the US-funded supply-side strategies, collectively called Plan Colombia, is that they will curb availability, drive the street price up, and ultimately reduce the demand and consumption of cocaine.[4] Yet wholesale prices for cocaine within the United States have actually decreased throughout the Plan Colombia era, suggesting an ever-abundant supply.[5]

Supply-reduction programmes, which under Plan Colombia rely heavily upon aerially-sprayed herbicides, have been implemented without a clear understanding of the factors that drive sub-national cultivation patterns. Forced eradication efforts, as a result, have amounted to large-scale 'weed-whacking'. This is evident in US State Department reports, which state that attempted cultivation in Colombia continues to expand despite increasing efforts to suppress cultivation. Attempted coca production – defined as eradicated plus un-eradicated coca – has risen by 36 per cent since 2000.[6]

The failure of eradication efforts and of coca's apparent cultivation shifts within the Andean region can be characterised as a balloon-effect, where production squeezed off in one locale simply forces illicit coca production

[2] United Nations Office on Drugs and Crime (UNODC), *Colombia Coca Survey* (New York 2005).

[3] Angel Rabasa and Peter Chalk, *Colombian Labyrinth: The Synergy of Drugs and Insurgency and Its Implications for Regional Stability* (Santa Monica 2001); Ricardo Vargas, 'The Anti-Drug Policy, Aerial Spraying of Illicit Crops and Their Social, Environmental and Political Impacts in Colombia', *The Journal of Drug Issues*, vol. 22, no. 4 (2002), pp. 11–60; María Clemencia Ramírez Lemus, et al., 'Colombia: A Vicious Circle of Drugs and War', in Coletta A. Youngers and Eileen Rosin (eds.), *Drugs and Democracy in Latin America: The Impact of US Poli*cy (London 2005), pp. 61–97.

[4] Coletta A. Youngers and Eileen Rosin, 'The US "War on Drugs": Its Impact in Latin America and the Caribbean', in Coletta A. Youngers and Eileen Rosin (eds.), *Drugs and Democracy in Latin America: The Impact of US Policy*, (London 2005), pp. 1–13.

[5] 'Battles won, a war still lost; Drugs in Latin America', *The Economist*, vol. 374 (2005), pp. 35–6.

[6] Washington Office on Latin America (WOLA), 'Memorandum to Foreign Policy Aids-Appropriations. Rethinking Plan Colombia: As Drug Control Policy, Plan Colombia Doesn't Measure Up.' (10 June 2005), http://www.wola.org/media/June%202005%20FY2006%Approps%20for%20Colombia.pdf

into new geographic areas. The balloon-effect can be observed since Plan Colombia's commencement, with both a reversed displacement of coca to surrounding countries and a dispersion and reconstitution of coca-growing areas within rural Colombia.[7] While 2005 saw an eight per cent increase in overall cultivation in Colombia, 44 per cent of the fields where coca was detected in 2005 had never before been identified as coca-producing fields.[8] While the balloon-effect indicates the apparent resilience and mobility of the coca crop, it lacks explanatory power. What explains the geographic expansion of coca cultivation within Colombia? What drives coca to be cultivated in certain geographic areas and not others? What are the requisite preceding conditions to facilitate its cultivation? Diverse hypotheses address the origin and causes of coca production in Colombia, but most are based on much qualitative, and little quantitative, evidence.[9]

In order to answer these research questions, this article reviews existing explanations of coca cultivation and develops an explanation of coca cultivation in Colombia that emphasises the local conditions that promote its proliferation. This study utilises the most recently published times-series cross-section data for 32 sub-national departments between 2001 and 2005 to examine explanations of Colombian coca cultivation following the inception of Plan Colombia in 1999. The results offer support for the reallocation of aerial eradication funds toward the development of localised public and market infrastructures as a long-term strategy for reducing coca production. The results also suggest that, despite official claims to the contrary, aerial eradication does not significantly reduce coca cultivation in Colombia, and that where it does have an impact, this is both temporary and in part due to displacement associated with fumigation efforts, generating significant human and economic costs. Also, coca cultivation in Colombia tends to occur in agricultural departments characterised by limited market access and state presence. The analysis modifies the general assumption that extreme poverty is a determinant of coca cultivation in Colombia by illustrating a parabolic relationship between poverty and coca cultivation in Colombia, where both very low and extremely high levels of poverty are associated with low rates of coca cultivation. Taken together, these results

[7] Ramírez Lemus, et al., 'Colombia: A Vicious Circle of Drugs and War'.

[8] United Nations Office on Drugs and Crime (UNODC), *Colombia Coca Survey* (New York 2006).

[9] Exceptions are Moreno-Sanchez, et al., 'An Econometric Analysis of Coca Eradication Policy in Colombia', and Ana María Díaz and Fábio Sánchez, 'A Geography of Illicit Crops (Coca Leaf) and Armed Conflict in Colombia', Crisis States Programme Working Paper no. 47, (London July 2004). The former is a time-series analysis of national cultivation rates, and the latter looks at diffusion of cultivation to nearby departments. Neither study includes the wide range of control variables included here. UNODC reports use bivariate analyses. See UNODC, *Colombia Coca Survey*, 2005 and 2006.

suggest that coca cultivation is most likely in areas with sufficient labour and land resources for production but that lack sufficient public infrastructure and state presence to facilitate production for legal markets. The following section reviews the existing hypotheses regarding the factors that explain coca cultivation. A description of the data used to describe each variable and its hypothesised effect precedes a discussion of the results of the statistical analysis, including the substantive and statistical significance of each variable. The article concludes with a brief discussion of the policy implications of our findings.

Explaining Coca Cultivation in Colombia

Challenges in the effective analysis of coca production abound, particularly in Colombia, due to the labyrinthine and highly politicised nature of the problem. Anti-coca policies in Colombia have been propelled not by analytic study of coca cultivation itself, but rather by external political pressures and counterinsurgency efforts. Debate surrounding the militarisation of forced eradication through Plan Colombia is inflamed by persistent questions regarding the overall effectiveness, as well as the unintended social, environmental and health consequences, of herbicide-based eradication.[10] Statistical testing of the effectiveness of different supply-side programmes has only recently become possible due to the availability of sub-national data on cultivation in Colombia, collected through aerial observation over the last several years. This paper uses department-level cultivation data to model the theoretical factors, including market, state and socio-economic characteristics, hypothesised to explain sub-national patterns of coca cultivation in Colombia.

Market theories point to Colombia as a strategic locale for coca production. Not only is it located within the Andean coca-producing region near convenient air and sea routes to North American and European markets, but it also houses large, isolated internal regions where the presence of the state is weak.[11] US officials approach coca cultivation in Colombia as the supply side of a larger market cycle run by narco-traffickers increasingly associated with Colombia's illegal armed groups. This cycle, officials from US and Colombian governments argue, can be forcibly disrupted through tougher

[10] Adam Isacson, 'The US Military in the War on Drugs', in Coletta A. Youngers and Eileen Rosin (eds.), *Drugs and Democracy in Latin America: The Impact of US Policy*, (London 2005), pp. 15–60; Rosin and Youngers, 'The US "War on Drugs": Its Impact in Latin America and the Caribbean'; Vargas, 'The Anti-Drug Policy, Aerial Spraying of Illicit Crops and Their Social, Environmental and Political Impacts in Colombia'; Ramírez Lemus, et al., 'Colombia: A Vicious Circle of Drugs and War'.

[11] Francisco E. Thoumi, *Illegal Drugs, Economy, and Society in the Andes* (Washington DC 2003).

mechanisms of law and order.[12] Subscribing to market theories of supply and demand, US officials assert that worsened profit margins, both real and perceived, would cause coca growers to abandon the crop and seek alternative economic endeavours. For example, the US State Department concludes, 'Crop control is by far the most cost-effective means of cutting supply. If we destroy crops or force them to remain unharvested, no drugs will enter the system'.[13] The US government argues that aggressive fumigation of land dedicated to coca should decrease both the net amount of coca presently cultivated and future attempted cultivation.

Launched bilaterally in 2000, Plan Colombia's principle strategy for reducing coca cultivation involves aerial fumigation by *Dirección Antinarcóticos* (DIRAN), Colombia's anti-narcotics police. In 2005, after five consecutive years of increases, and with support from the US Embassy, State Department and private contractors, the Colombian government sprayed a total of 138,367 hectares in 18 of Colombia's coca-growing departments. Notwithstanding this, the total area under coca cultivation increased by eight per cent between 2004 and 2005, representing a total of eight per cent of Colombia's national territory.[14] The funds and overall resources expended on combating coca via forced eradication are similarly notable, particularly those devoted to its security component. Up to 75 per cent of the US$ 4.7 billion in US Plan Colombia funding has been allocated to the Colombian police and military forces, which in 2000 launched counter-narcotics brigades to secure the flight paths of fumigation aircraft.[15]

In response to eradication efforts, coca growers in Colombia have compensated in unexpected ways. They either grow greater quantities in smaller but more dispersed plots, or they clear plots in areas even further from state infrastructure, a reflection of the balloon effect.[16] Furthermore, there is mounting evidence that the socioeconomic disruption and intensified violence produced by Colombia's fumigation strategy displaces thousands of rural Colombians each year and may indirectly contribute to the subnational proliferation of coca to new areas.[17] Displacement refers to the forced migration of people from their place of residence. While much of Colombia's internal displacement – which averaged 281,230 people between

[12] Isacson, 'The US Military in the War on Drugs'.

[13] United States State Department, Bureau for International Narcotics Control and Law Enforcement, 'Policy and Program Developments', International Narcotics Control Strategy Report, 1 March 2004, http://www.state.gov/p/inl/rls/nrcrpt/2003/vol1/html/29829.htm

[14] UNODC, *Colombia Coca Survey* (2006).

[15] Ramírez Lemus, et al., 'Colombia: A Vicious Circle of Drugs and War'.

[16] UNODC, *Colombia Coca Survey* (2006).

[17] Isacson, 'The US Military in the War on Drugs'; Ramírez Lemus, et al., 'Colombia: A Vicious Circle of Drugs and War'; Vargas, 'The Anti-Drug Policy, Aerial Spraying of Illicit Crops and Their Social, Environmental and Political Impacts in Colombia.'

2000 and 2005 – is directly attributable to intimidation and violence initiated by guerrilla and paramilitary groups, fumigation itself fosters displacement because it destroys peasants' subsistence patterns by wiping out both their illicit and licit crops.[18] Colombia's nongovernmental Council for Human Rights and Displacement estimates that in 2001 and 2002 – the two years following Plan Colombia's inception – fumigation alone displaced more than 75,000 people nationwide.[19] In addition, Colombia's militarised eradication strategies appear to produce intensified displacement in areas targeted for fumigation as state, guerrilla and paramilitary elements vie for military, economic and popular control.[20] This suggests that while aerial eradication may directly reduce coca cultivation in some areas through the eradication of plants, it may also *indirectly* reduce cultivation by generating localised displacement. This article estimates both the direct effects and indirect effects, via displacement, of aerial spraying on local coca cultivation.

It should be noted that most of Colombia's displaced do not grow coca and that the displaced also tend to migrate to its urban centres. Nevertheless, forced eradication does generate a dispossessed labour force pre-equipped with coca production know-how. Anecdotal reports indicate that Colombia's rural displaced, as a means of survival in their new locales, often engage in and proliferate the cultivation, harvesting and production of coca.[21] In addition, there is evidence that elements of Colombia's floating population migrate to coca-producing regions specifically in search of the economic opportunities afforded by the illicit drug industry.[22] These studies suggest that rural areas receiving people displaced by eradication efforts experience increased coca cultivation.

[18] Estimates of displacement from, Ministerio de la Protección Social, 'Consolidado de Programas.' (2005), http://mps.minproteccionsocial.gov.co/consolidado/buscar.php. On violence of guerrilla and paramilitary groups contributing to displacement, see Ana María Ibáñez and Carlos Eduardo Velez, 'Civil Conflict and Forced Migration: The Micro Determinates and the Welfare Losses of Displacement in Colombia', Documento CEDE 2005-35, Universidad de los Andes (Bogotá, June 2005) and Stefanie Engel and Ana María Ibáñez, 'Displacement Due to Violence in Colombia: A Household-Level Analysis', *Economic Development and Cultural Change*, vol. 55, no. 2 (2007), 335–66. On the effects of fumigation on displacement, see Ramírez Lemus, et al., 'Colombia: A Vicious Circle of Drugs and War'.

[19] UNODC, *Colombia Coca Survey* (2004).

[20] Isacson, 'The US Military in the War on Drugs'; Ramírez Lemus, et al., 'Colombia: A Vicious Circle of Drugs and War'. Jennifer S. Holmes et al. find that coca eradication, and not coca cultivation, appears to contribute to leftist guerrilla violence. Jennifer S. Holmes et al., 'Drugs, Violence, and Development in Colombia: A Department-Level Analysis', *Latin American Politics and Society* vol. 48, no. 3 (2006): pp. 157–84.

[21] Ramírez Lemus, et al., 'Colombia: A Vicious Circle of Drugs and War'; UNODC *Colombia Coca Survey* (2005); Thoumi, *Illegal Drugs, Economy, and Society in the Andes*.

[22] Rabasa and Chalk, *Colombian Labyrinth: The Synergy of Drugs and Insurgency and Its Implications for Regional Stability*.

Unfortunately, the aerial eradication strategy implies a failure to fully appreciate coca's several comparative advantages as a cash crop within the regions where it is grown. First, coca is hardier than most other crops; it can grow on poor-quality or depleted soil and steeply-sloped terrain and is relatively resistant to climate variations and pests. Coca plants can provide initial harvests in as little as six months of planting and from three to six times per year, which provides a year-round income that seasonal crops cannot offer. Second, coca requires little in the way of processing infrastructure and is well suited to low-cost, long-range transport that does not depend on access to good roads.[23] Beyond Colombia, cross-continental studies conclude that coca growing regions are some of the most underdeveloped agricultural areas of the world, where growers suffer from lack of market access.[24] In Colombia, coca grows in regions that lack access to regional markets and cities, where rough terrain and civil conflict have impeded the construction of viable roadways.[25] Colombia's traditional coca-growing departments of Putumayo, Caqueta and Guaviare are located deep within the Amazonian jungle, where villages can be several days travel away from the nearest regional market.[26] Given these characteristics, it is not surprising that participants of the UNODC's Andean-wide survey ranked a lack of viable, stable markets for alternative crops as their number one reason for rejecting legal agronomic activities.[27] Similarly, econometric studies show that prices of key alternative crops in Colombia are negatively related to coca production,[28] and anecdotal evidence supports claims that coca traders, and increasingly illegal armed groups, offer growers almost guaranteed markets with stable farm-gate prices and access to credit and seeds.[29] Therefore, though coca can be grown on marginal land, it is also particularly likely to be grown in agricultural regions with underdeveloped roads and market infrastructure where other less hardy and more perishable crops would be

[23] Kevin J. Riley, 'Snow Job? The Efficacy of Source Country Cocaine Policies', Graduate School Dissertation Series RGSD-102, National Defense Research Institute, 1993.

[24] UNODC, *Alternative Development: A Global Thematic Evaluation – Final Synthesis Report* (New York 2005).

[25] Thoumi, *Illegal Drugs, Economy, and Society in the Andes.*

[26] Nancy McGuire, 'Combating Coca in Bolivia and Colombia: A New Perspective on the Forces that Drive Peasant Coca Farming', Report for Council For Emerging National Security Affairs, Washington, D.C.

[27] UNODC, *Alternative Development: A Global Thematic Evaluation – Final Synthesis Report* (New York 2005).

[28] Moreno-Sanchez, et al., 'An Econometric Analysis of Coca Eradication Policy in Colombia'.

[29] Ana María Díaz and Fábio Sánchez, 'A Geography of Illicit Crops (Coca Leaf) and Armed Conflict in Colombia'; David Mansfield, 'Alternative development: the modern thrust of supply-side policy', *Bulletin on Narcotics–Occasional Papers*, vol. L1, nos. 1 & 2 (1999) pp. 19–44.

less successful. Though much of the discussion surrounding coca cultivation in Colombia emphasises its utility as a cash crop that enhances the ability of rural Colombians to subsist,[30] quantitative, cross-Colombian studies that relate the relative availability of licit agricultural markets to coca cultivation levels are lacking.

In addition to underdeveloped market infrastructure, an underdeveloped public infrastructure or lack of state presence can also directly contribute to higher levels of coca cultivation. Up to 40 per cent of Colombia's territory remains effectively beyond the control of the state, which has not exercised a consistent presence throughout its territory.[31] Lack of state presence and infrastructure can contribute directly to increased coca cultivation by limiting the range of legal economic activities available to residents.[32]

Weak state presence can also contribute to coca cultivation by providing a vacuum in which illegal armed groups compete for or establish dominance. In areas beyond effective state control, illegal armed groups may operate. The principal groups are the leftist Revolutionary Armed Forces of Colombia (FARC), the smaller National Liberation Army (ELN), and paramilitary groups created by wealthy land-owners and drug-traffickers, such as the United Self-Defence Groups of Colombia (AUC). In areas with weak state presence, the groups fight federal forces and each other not only for territorial control and access to strategic trafficking corridors, but for control of the economic resources within their areas of operation. Often the drug trade finances the activities of illegal armed groups, and the one strengthens and perpetuates the existence of the other. The result is a proliferation of illegal armed groups in many of Colombia's ungoverned rural regions.[33]

Some argue that illegal armed groups should lead to higher rates of coca cultivation.[34] This is consistent with reports that Colombia's illegal groups have, in some regions, substituted for an absent state and imposed their own regimes, defining their own laws and regulations and providing basic education, a police force, and civil justice system to solve conflicts among the population. In exchange for public order, the groups demand popular allegiance and impose a tax on peasants' productive activities, including coca

[30] UNODC, *Colombia Coca Survey* (2005).

[31] Jennifer S. Holmes, et al., 'A Subnational Study of Insurgency: FARC Violence in the 1990s', *Studies in Conflict and Terrorism*, vol. 30, no. 1 (2007), pp. 249–65.

[32] Moreno-Sanchez et al., 'An Econometric Analysis of Coca Eradication Policy in Colombia'.

[33] Rabasa and Chalk, *Colombian Labyrinth: The Synergy of Drugs and Insurgency and Its Implications for Regional Stability*.

[34] Moreno-Sanchez et al., 'An Econometric Analysis of Coca Eradication Policy in Colombia'.

cultivation.[35] Though traditionally Colombia's illegal armed groups have not participated directly in the production and supply chain, there is increasing evidence of their direct involvement in production and trafficking in some regions.[36] Further, in municipalities with both illegal group presence and coca cultivation, cultivation appears to be more intense.[37] Therefore, the absence of a state presence creates an environment that lacks sufficient opportunities for legal activities and is permissive of illicit activities, including those of illegal armed groups. Weak state presence should be directly associated with higher rates of coca cultivation.

At the same time, when weak state presence permits violence perpetrated by illegal armed groups intent on establishing economic and political control of a territory, then conflict-related displacement may interfere with coca cultivation. For example, studies suggest that weak state presence leads to higher levels of guerrilla violence.[38] In some areas where narco-traffickers once paid taxes to guerrillas to maintain a secure operating environment, the traffickers have instead created their own paramilitaries, leading to escalations in violent conflicts between these and guerrilla forces.[39] Interestingly, the same studies find that coca cultivation itself is not a significant cause of guerrilla violence.[40] Consequently, we might expect weak state presence to be associated with higher levels of displacement and thus lower levels of coca cultivation.

In addition to such factors as market conditions, state presence, and displacement, Colombia's colonisation resulted in inefficient bureaucracies, ill-equipped to govern Colombia's swaths of rough frontier, where cutting corners in pursuit of survival or individual advancement became, if not institutionally encouraged, at least socially tolerated.[41] This environment of unregulated individualism fostered practices of corruption that allowed large areas of the country to function independently of centralised control, and meant that ungoverned regions became, in effect, ungovernable. This

[35] Ricardo Vargas, *Drug Cultivation, Fumigation and the Conflict in Colombia* (Bogota, 1999); Rabasa and Chalk, *Colombian Labyrinth: The Synergy of Drugs and Insurgency and Its Implications for Regional Stability*; Thoumi, *Illegal Drugs, Economy, and Society in the Andes*.

[36] Rabasa and Chalk, *Colombian Labyrinth: The Synergy of Drugs and Insurgency and Its Implications for Regional Stability*; Thoumi, *Illegal Drugs, Economy, and Society in the Andes*.

[37] UNODC, *Colombia Coca Survey* (2005); Díaz and Sánchez, 'A Geography of Illicit Crops (Coca Leaf) and Armed Conflict in Colombia'.

[38] Holmes et al., 'Drugs, Violence, and Development in Colombia: A Department-Level Analysis'; Holmes, et al., 'A Subnational Study of Insurgency: FARC Violence in the 1990s'.

[39] Holmes et al., 'A Subnational Study of Insurgency: FARC Violence in the 1990s'.

[40] Holmes et al., 'Drugs, Violence, and Development in Colombia: A Department-Level Analysis'; Holmes, et al., 'A Subnational Study of Insurgency: FARC Violence in the 1990s'.

[41] Thoumi, *Illegal Drugs, Economy, and Society in the Andes*.

culture of corruption prevails throughout Colombia's coca-growing regions, further facilitating the expansion of cultivation.[42]

Finally, poverty and illicit crop production tend to overlap, and international studies describe illicit cultivation areas as characteristically poor, where indicators of malnutrition, infant mortality and illiteracy are consistently and substantially higher than national averages. Specifically, there tends to be an Andean-wide association between the size of landholdings and the proportion of land dedicated to coca cultivation, where those with the least amount of land were found to cultivate the largest proportion of their holdings with coca.[43] An estimated 60 per cent of Colombia's coca crops are on small landholdings of less than two hectares, indicating that coca cultivation in Colombia is part of a wider cropping pattern aimed at self-sufficiency.[44] The UNODC asserts that while growing coca does not significantly increase the income of rural Colombians, of whom 85 per cent live below the international poverty line, it can serve to improve their basic subsistence in the absence of other income generating activities.[45]

However, in a department-level analysis, the UNODC found no statistically significant correlation between poverty and coca cultivation within Colombia.[46] The study notes that departments like Guainía and Choco, where poverty levels were high, were not the departments with high levels of coca cultivation in 2004, whereas the department of Meta, with relatively fewer people below the poverty line, accounted for a significant portion of Colombia's coca cultivation. Though the UNODC found no linear relationship, its findings do not preclude a curvilinear relationship between poverty and coca cultivation. Coca cultivation may be limited in areas with very little poverty and become more widespread as poverty increases. However, it is not likely that areas with very high concentrations of poverty will have sufficient resources to sustain coca production. Therefore, we might reasonably expect the relationship between poverty and coca cultivation to flatten at the highest levels of poverty.

This section has reviewed a variety of factors that are likely to explain the sub-national pattern of coca cultivation in Colombia, including aerial eradication, displacement, corruption, state presence, economic development, agricultural activity, access to agricultural markets, and poverty.

[42] Francisco E. Thoumi, 'Why the Illegal Psychoactive Drugs Industry Grew in Colombia', Journal of Interamerican Studies and World Affairs, vol. 34, no. 3 (1992), pp. 37–63; Thoumi, *Illegal Drugs, Economy, and Society in the Andes*.

[43] UNODC, *Alternative Development: A Global Thematic Evaluation – Final Synthesis Report*; Mansfield, 'Alternative development: the modern thrust of supply-side policy'.

[44] Díaz and Sánchez, 'A Geography of Illicit Crops (Coca Leaf) and Armed Conflict in Colombia'. [45] UNODC, *Colombia Coca Survey* (2005). [46] UNODC, *ibid.*

Table 1. *Variable Definitions and Hypothesised Effects*

Dependent variable	Description	
Coca Cultivation	Square kilometres of coca under cultivation in each department, divided by the rural population	
Independent variables	**Description**	**Impact On DV**
Aerial eradication	Percentage of department land area aerially fumigated	−
State presence	Public administration and community services output (in thousands of constant pesos) divided by the population	+
Displaced	Number of persons displaced from department of origin divided by the population	−
Incoming displaced	Number of displaced persons resettling in destination department divided by the population	+
Corruption	Department government corruption index, 0 to 100	+
Licit Agriculture	Licit agricultural output (in thousands of constant pesos) divided by rural population	+
GDP per capita	Department gross domestic product per capita (in thousands of constant pesos)	−
Market access	Paved roads as percentage of all roads	−
Poverty	Percentage of population with unsatisfied basic needs	+/−

The following section articulates the specific hypotheses to be tested and describes the data used in the statistical analysis that follows.

Hypotheses and Data

Colombia is divided into 32 administrative territorial departments. The time-series, cross-section dataset consists of department level, annual observations for each independent variable from 2000 to 2004, and the dependent variable, coca cultivation, from 2001–2005.[47] Descriptions of the variables and their hypothesised effects on cultivation can be found in Table 1.

The analysis begins in 2001 because this is the first year that full national coverage was achieved from UNODC and the Colombian government's use of satellite imagery and verification flights over coca growing areas to monitor the location and spread of coca cultivation. In 2005, the area within each department with active coca cultivation was between 28 and 17,305 hectares, with nine departments having no reportable levels of coca cultivation.[48] Because the urbanisation and territory of each department

[47] Colombia's federal district, Bogotá, is excluded from analysis. Annual data for roadways, government corruption, and poverty are not collected or published.

[48] See UNODC, *Colombia Coca Survey* (2005) for data and a discussion of measurement issues.

differ, we calculate per capita cultivation rates by dividing the annual square kilometres under cultivation within each department by its rural population.[49]

Aerial fumigation by DIRAN is the Colombian government's primary method for reducing coca cultivation.[50] In 2000, it sprayed 58,498 hectares in 11 of the country's previously identified coca-growing departments. Coverage has expanded annually under Plan Colombia, and in 2004 targeted over 136,552 hectares across 16 departments. Aerial eradication is the percentage of department land area aerially fumigated by DIRAN.[51] The direct effect of aerial fumigation on coca cultivation should be negative.

Coca cultivation appears to occur in communities beyond the effective reach of the state because weak state presence creates permissive conditions that enable illegal activity.[52] In Colombia, department level governments have fiscal and operational responsibility for basic services and infrastructure. State presence in each department, calculated by dividing public administration and community services output (in thousands of constant pesos) by population, is hypothesised to be negatively associated with coca cultivation.[53]

Aerial eradication efforts and lack of state presence are also expected to affect coca cultivation indirectly, through their effects on displacement. Eradication contributes to displacement through its disruption of both legal and illegal cultivation and the violence associated with military efforts to secure areas for fumigation. Weak state presence contributes to displacement when illegal armed groups compete for control of remote areas. The Colombian government works with non-governmental agencies and the Catholic Church to compile the *Sistema Unico de Registro* (SUR), a database of

[49] Colombia's departments range from 24.1% to 93.7% urban. Joshua D. Angrist and Adriana D. Kugler, 'Rural Windfall or a New Resource Curse? Coca, Income and Civil Conflict in Colombia', National Bureau of Economics Research Working Paper No. 11219, Cambridge, MA, March 2005. Population data come from the Colombian Government's statistical database, the *Departamento Administrativo Nacional de Estadistica* (DANE), http://www.dane.gov.co. Unless otherwise stated, all data used in this study are retrieved from DANE.

[50] Accumulated sprayed area is the sum of areas sprayed during a given time period, calculated by multiplying the length of flight lines by their width. It does not take into account effective sprayed area, which disregards the overlap between adjacent sprayed bands and areas sprayed several times in the same calendar year. UNODC, *Colombia Coca Survey* (2005).

[51] Aerial eradication data from UNODC, *Colombia Coca Survey* (2006).

[52] Though weak state presence may facilitate coca cultivation by enabling illegal armed groups to protect or promote cultivation, it is difficult to directly measure the magnitude of armed group presence without conflating this with violence. Typically, human rights violations or other estimates of violence are used to measure armed group presence. However, these measures should actually be associated with *less* cultivation due to the displacement and disruptions of cultivation associated with such violence.

[53] DANE, http://www.dane.gov.co/files/investigaciones/pib/departamentales/

internally displaced persons.[54] Federal law defines database entrants as migrants forced to abandon their physical residences and employment activity by armed conflict, generalised violence, massive human rights violations or other circumstances that threaten or drastically alter public order. In describing internal displacement, SUR distinguishes between departments where original displacement occurs, and the departments where displaced persons relocate. This distinction is analytically important, because displacement reflects the existence of a migratory cause. In areas with high displacement, we would expect cultivation to decline due to the disruption of agricultural activities, both licit and illicit, and of the local labour market. Reception rates, in contrast, reflect the presence of floating populations that seek employment. Some argue that the presence of displaced populations is positively associated with coca cultivation, although this correlation is weakened since displaced populations often flee to urban destinations.[55] For this study, 'displaced' measures the ratio of the annual number of displaced persons to the total population in the department of origin. 'Incoming displaced' measures the ratio of annual displaced persons to the total population in the department of settlement.[56]

In addition, widespread public corruption in Colombia encourages unregulated individualism among the civilian population, which facilitates the expansion of the coca industry within Colombia.[57] Transparency International assessed Colombia's department-level governments using a corruption index scaled 0–100 with weighted categorical variables that measure internal and external transparency in fiscal management, adherence to operational mandates, and the responsiveness of Colombia's department-level governments. Higher outcomes on the corruption index are hypothesised to be positively associated with higher rates of coca cultivation.

[54] Presidencia República de Colombia,'Registro Único de la Población Desplazada', http://www.red.gov.co/programas/apoyo_integral_ desplazados/estadisticas.htm

[55] See Ramírez Lemus, et al., 'Colombia: A Vicious Circle of Drugs and War'; UNODC *Colombia Coca Survey* (2005); Thoumi, *Illegal Drugs, Economy, and Society in the Andes*; and Rabasa and Chalk, *Colombian Labyrinth: The Synergy of Drugs and Insurgency and Its Implications for Regional Stability*.

[56] The SUR database probably underestimates the true number of displaced, in part because the government uses a more restrictive definition of displacement than that of NGOs. On the other hand, the government's SUR database has the advantage of tracking, in addition to the department in which the displaced settle, the department from which people are displaced. This allows us to disaggregate the effects of displacement in both sending and receiving departments. CODHES, a Colombian NGO, only publishes data on the departments that receive the displaced. Using the government figures reflects the more conservative approach because any effects we find would be more pronounced were more accurate data available. See Internal Displacement Monitoring Centre, 'Colombia: government 'peace process' cements injustices for IDPs', Norwegian Refugee Council, Geneva, Switzerland, 30 June 2006.

[57] Thoumi, *ibid.*

Coca is also more likely to be cultivated in agricultural regions, especially when controlling for a department's level of economic development. Even though coca can be cultivated on marginal land, agricultural areas have the resources necessary for cultivation, especially in comparison to more urbanised areas. Licit agricultural production is measured by the department-level gross domestic product (GDP) in thousands of constant pesos derived from agricultural activities, divided by the rural population. Level of economic development is measured as departmental per capita gross domestic product (GDP) in thousands of constant pesos.[58] Even when controlling for both economic development and agricultural production, coca cultivation should be more likely in areas that lack agricultural market access. Market access is measured in terms of paved roads as a percentage of all intra-departmental roads.[59]

While it would be useful to separate structural and income indicators of poverty, economic indicators in terms of income levels, unemployment and underemployment in Colombia are not published at the department level.[60] DANE utilises the Unsatisfied Basic Needs (UBN) Index to measure poverty at the department level. The indicator, ranging from zero to 100, is the percentage of households for which one or more of poverty indicators are present. The poverty indicators include the materials with which the house is made, water and sewage services, degree of economic dependence, number of people per square metre, and school attendance of at least one child between the age of seven and eleven.[61] While poverty is generally assumed to be positively associated with coca cultivation, sub-national studies have experienced difficulty in establishing a statistically significant, linear relationship between poverty and coca cultivation.[62] Because coca cultivation may be less common at both very low and very high levels of poverty, the statistical analysis will test whether an inverted-U relationship exists between poverty and coca cultivation remains when controlling for other variables.

[58] For department level GDP and population statistics, see DANE, http://www.dane.gov.co/

[59] Ministerio de Transporte, 'Transporte en cifras', http://www.mintransporte.gov.co/Servicios/Estadisticas/TABLASYGRAFICOS2004.htm.

[60] For a discussion of these data issues, see Holmes et al., 'Drugs, Violence, and Development in Colombia: A Department-Level Analysis'. Data to test hypotheses that focus on factors of inequality, including the potential association between coca cultivation and land ownership, prove similarly elusive.

[61] The Colombian government is in the process of adopting a new measure of poverty based on data projections. The UPN and this new measure, the System for Selecting Beneficiaries of Social Services (SISBEN), are highly correlated.

[62] UNODC, *Colombia Coca Survey* (2005).

Model Results

The relationships between the variables described above and coca cultivation in Colombia are analysed using a Prais-Winsten regression model estimated with panel corrected standard errors and fixed effects. Pooling the data increases estimation efficiency by increasing the observable cases from 32 to 160, but pooled data often violate the assumptions of ordinary least square (OLS) regression, and as a result can exhibit panel heteroscedasticity and autocorrelation. Estimating the model with heteroscedastic panel corrected standard errors accounts for panel heteroscedasticity.[63] Autocorrelation of the errors was addressed by estimating the model using a Prais-Winsten transformation with a common autoregressive parameter.[64] Panel fixed effects model were included to account for unobserved differences across the Colombian departments.[65]

[63] Nathaniel Beck and Jonathan N. Katz, 'What to do (and not to do) with Time-Series Cross-Section Data', *American Political Science Review*, vol. 89, no. 3 (1995), pp. 634–47. Beck and Katz's panel corrected standard errors (PCSEs) typically perform better when the number of time points exceed the number of cross-sections. In this instance, the PCSEs are nearly identical to uncorrected standard errors using OLS. Limited data and a large number of parameters preclude estimation of accurate generalized least squares models with complex corrections for assumed error structures.

[64] The other modelling alternative to deal with autocorrelation would entail estimating the model using OLS and including a lagged dependent variable. In this case, the lagged dependent variable approach would be problematic or unnecessary. The lagged dependent variable approach would use up scarce degrees of freedom and convert the analysis into one of short-term change, despite our theoretical interest in cross-department variation. Further, the estimates of the autocorrelation parameter (rho) in the Prais-Winsten models suggests that autocorrelation within panels is not severe. Further, a lagged dependent variable is problematic with the inclusion of fixed effects, creating additional bias beyond that normally expected in such models.

[65] Two tests were used to determine whether fixed effects were appropriate, and both indicated that estimating the model with fixed effects is necessary. First, a Chow or F test of the joint significance of the coefficients for the fixed effects generated statistically significant Chow scores (see Table 2). In addition, the modified jack-knife procedure recommended to measure the mean absolute prediction error for each department, also confirmed the utility of estimating the model with fixed effects. The jack-knife procedure estimates a separate prediction model for each department by leaving out one department at a time and using the model to predict coca cultivation in the omitted department. The mean absolute error is the difference between the predicted and observed coca cultivation for each department. The results of the test are presented in the Appendix. See Nathaniel Beck. 'Time-Series-Cross-Section Data: What Have We Learned in the Past Few Years?', *Annual Review of Political Science*, vol. 4 (2001): pp. 271–93.Fixed effects are also preferable to random effects because it is unlikely that the intercept shifts are due to random error uncorrelated with the independent variables, an assumption required of random effects models. Instead, the intercepts shifts are likely to reflect systematic differences in the average level of coca cultivation across departments rather than random error. We performed a Hausman test, which indicated that the random effects were not more efficient than fixed effects. The estimates of the random effects models were inconsistent. We accept the loss of efficiency in the fixed effects models in favour of greater consistency.

Table 2. *Colombian department-level coca cultivation, 2001–2005*

	Model 1		Model 2	
	β (PCSE)	Standardized β	β (PCSE)	Standardized β
Aerial eradication$_{t-1}$	−0.048	−0.001	−0.048	−0.001
	(2.049)		(2.049)	
State presence$_{t-1}$	−4.956***	−0.172	−4.956***	−0.172
	(1.706)		(1.706)	
Displaced$_{t-1}$	−133.647**	−0.270	−133.647**	−0.270
	(57.195)		(57.195)	
Incoming displaced$_{t-1}$	7.785	0.062	7.785	0.062
	(9.255)		(9.255)	
Corruption$_{t-1}$	0.108	0.128	0.120	0.143
	(0.086)		(0.085)	
Licit agriculture $_{t-1}$	4.736***	0.610	4.736***	0.610
	(1.027)		(1.027)	
Economic development$_{t-1}$	−0.001	−0.143	−0.001	−0.143
	(0.000)		(0.000)	
Market access$_{t-1}$	−0.203***	−0.650	−0.302***	−0.964
	(0.047)		(0.085)	
Poverty$_{t-1}$	0.188***	0.390	0.756**	1.569
	(0.071)		(0.312)	
Poverty$^2_{t-1}$			−0.007**	−1.815
			(0.003)	
Rho	0.111		0.111	
Wald χ^2 (df)	492.82 (38)***		492.82 (38)***	
Chow test for f.e. (df)	249.23 (29)***		190.47 (28)***	
R^2	0.9094		0.9094	
Observations	160		160	
Departments	32		32	

Note: Prais-Winsten regression with common AR-1 autocorrelation estimate (rho), fixed effects (not shown), and panel corrected standard errors (in parentheses). Wald χ^2 and R^2 reported by Stata 9, using xtpcse command with common AR(1) option.

Key: * $p < 0.10$, ** $p < 0.05$, *** $p < .001$, two-tailed tests.

Table 2 presents the results for two models, one with poverty as a linear predictor of cultivation (Model 1) and a second with a non-linear relationship between poverty and cultivation (Model 2). The results for both models are nearly identical, and the discussion below will focus on those for Model 2. Standardised coefficients are also presented to facilitate comparisons of explanatory power across different independent variables.

According to the results, aerial eradication has a small and statistically insignificant direct effect on coca cultivation in Colombia. The small size of the substantive direct effect on coca cultivation is clear because aerial eradication has the smallest standardised coefficient of the model. In addition, both displacement and state presence have substantively and statistically significant dampening effects on coca cultivation, according to the

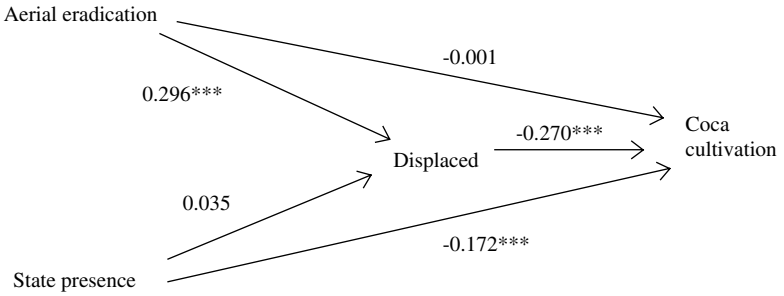

Fig. 1. *Relationships among aerial eradication, state presence, displacement and coca cultivation.* Note: *Standardised betas from Table 2, Model 2 and regression of displaced on aerial eradication and state presence. *** $p < 0.001$, two-tailed test.*

model results in Table 2. These findings are consistent with expectations that displacement disrupts agricultural activity and labour markets and thus coca cultivation, and that a strong state presence precludes extensive illegal activities, including coca cultivation.

To better understand the complex relationships among aerial eradication, state presence, displacement, and coca cultivation, we also estimated a limited model of displacement. The category 'displaced' was regressed on aerial eradication and state presence to estimate the role of these two variables on the rate of displacement. Figure 1 illustrates the path relationships among eradication, state presence, displaced population and coca cultivation. The path coefficients are the standardised betas from Model 2 and the model of displacement described above.

This exercise confirms that though aerial eradication has only a marginal *direct* effect on coca cultivation (-0.001, $p > 0.100$), it has a significant effect on displacement (0.296, $p < 0.001$) and thus does contribute indirectly to local reductions in coca cultivation. While the direct effect of aerial eradication on coca cultivation is modest (-0.001), the indirect effect via displacement is larger (-0.080, the product of 0.296 and -0.270). The total effect of aerial eradication on coca cultivation (-0.081, or -0.001 plus -0.080) is still modest, compared to some of the other variables in Model 2. The model suggests that much of the effect of aerial eradication on coca cultivation occurs through displacement of the population, which implies significant and unintended human and economic costs of the eradication policy.[66] At a minimum, the result suggests that the effectiveness and externalities of aerial eradication should be more closely examined.

[66] Studies of the effect of displacement on welfare suggest that it reduces by a third the consumption of the displaced. Ana Maria Ibáñez and Carlos Eduardo Velez, 'Civil Conflict and Forced Migration: The Micro Determinates and the Welfare Losses of Displacement in Colombia'.

Figure 1 also provides some insight into the relationship between state presence and coca cultivation. A strong state presence clearly directly reduces the extent of coca cultivation (-0.172, $p < 0.001$).[67] Meanwhile, state presence does not have a significant direct effect on displacement (0.035, $p > 0.100$). This finding suggests that weak state presence does not necessarily correspond to increases in displacement due to violence between illegal armed groups. Instead, a strong state presence is important because it directly reduces the intensity of coca cultivation in a department.

Overall, the simple path model results illustrated by Figure 1 suggest that future studies should more closely examine the complex relationships between eradication, state presence, displacement, and coca cultivation. In particular, the results suggest that aerial eradication affects coca cultivation mainly through displacement, which entails significant human and economic side effects, and that a strong state presence directly reduces the intensity of coca cultivation, though state presence has little impact on displacement.

Most of the remaining indicators of state or market context are consistent with existing theoretical expectations, although not all of the variables have statistically significant effects on coca cultivation. For example, although areas that receive displaced populations *do* have slightly higher coca cultivation rates, even when controlling for departmental level of economic development, this effect is not statistically significant.[68] Likewise, coca cultivation is greater in departments with higher levels of corruption and lower levels of economic development, though these effects are not statistically or substantively very significant. Coca cultivation is significantly higher, however, in agricultural regions, even after controlling for poverty and level of economic development. Not surprisingly, extent of legal agricultural production is one of the better predictors of coca cultivation because many of the resources necessary to produce agricultural goods for legal markets are the same as those necessary to produce for illegal markets: arable land, appropriate climate and sufficient labour. At the same time, not all agricultural

[67] Though we do not model the presence of illegal groups directly for reasons discussed above, the direct effect of state presence on cultivation is consistent with studies arguing that illegal armed group presence is associated with coca cultivation.

[68] We also estimated the models using the CODHES data for departments receiving the displaced. The results for all of the variables, except incoming displaced and aerial eradication, were nearly identical in terms of substantive and statistical significance to the models reported in Table 2. In the case of incoming displaced, the effect on coca cultivation remained positive but was smaller and even less statistically significant, which suggests that the displaced do not engage in significant coca cultivation. The coefficient for aerial eradication became larger but remained insignificant. That substituting the CODHES data for that of SUR only affected the coefficients of these two variables (and even then they remained statistically insignificant), suggests that the SUR figures do indeed under count those that are displaced by aerial eradication. Therefore, our results are conservative.

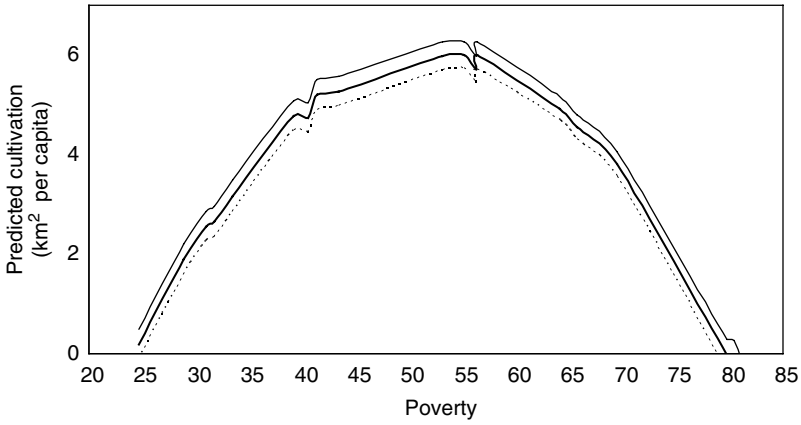

Fig. 2. *Predicted effect of poverty on coca cultivation with 95% confidence interval.* Note: *Simulated results estimated using CLARIFY in Stata with regress command with fixed effects. The model results were nearly identical to those reported for Model 2 in Table 2.*

areas have sufficient infrastructure to integrate producers into legal markets. Given the hardiness of coca as a cash crop, it is ideal to overcome barriers to market entry, including long distances or poor public infrastructure. The model supports this argument because coca cultivation is higher in areas with fewer paved roads, or poor access to legal markets for producers. Even controlling for level of economic development and state presence, the percentage of roads that are paved in a department has a substantively and statistically significant effect on reducing coca cultivation. This suggests that improving public infrastructure to provide agricultural producers with greater access to legal markets may be a useful strategy for combating coca cultivation in agricultural regions.

Finally, the models suggest that the relationship between poverty and coca cultivation may be more complex than is often assumed. The statistical analysis suggests that poverty has a statistically and substantively significant inverted-U relationship with coca cultivation rates, where very low and extremely high levels of poverty are associated with little coca cultivation.[69] Figure 2 presents the predicted cultivation rates according to Model 2, at

[69] Though the linear effect of poverty in Model 1 is statistically significant, the coefficient in Model 1 is much smaller than its counterpart in the quadratic model. The quadratic term in Model 2 is statistically significant. The results are consistent with an interpretation that the coefficient of the linear parameter in Model 1 is biased downward because of omitted variable bias. The jack-knife procedure confirms that the curvilinear model of poverty better predicts actual coca cultivation than poverty as a simple, linear predictor. See the Appendix.

levels of poverty found in the sample. The figure is based on simulations using CLARIFY, to account for sampling variability.[70] Indeed, when poverty exceeds 80 on the poverty index, as it does in some Colombian departments, the model predicts no coca cultivation. Coca cultivation is highest in regions of moderate poverty, peaking in those with UBN scores between 50 and 60. This suggests that regions with low rates of poverty will be less likely to engage in significant coca cultivation and also that regions with extremely high rates of poverty will also be too resource poor to have sufficient resources to engage in coca cultivation. From a policy standpoint, this relationship creates a conundrum because efforts to reduce poverty may have an untended consequence of facilitating the expansion of coca cultivation. This is why it is important to understand the myriad factors that contribute to regional patterns of coca cultivation so that coherent policies can be implemented not only to reduce cultivation but also reduce poverty and promote economic development.

Conclusions

The model developed in this article elucidates and reveals some of the complex factors explaining patterns of coca cultivation in Colombia since the implementation of Plan Colombia in 1999. The preceding analysis presents several findings, each with important policy implications for Plan Colombia and long-term strategies for reducing coca cultivation in Colombia.

First, the analysis illustrates the complex relationships existing between aerial eradication, displacement and coca cultivation. Aerial eradication, the centrepiece of Plan Colombia's efforts to stymie Colombian coca exports, has a small overall impact on coca cultivation, compared to other variables. Furthermore, the effects of aerial eradication on coca appear to derive not directly from the fumigation of the plant itself, but rather from the associated side effects of fumigation, namely, violence and indiscriminate disruption of agriculture in coca growing regions. That aerial eradication principally affects coca by generating significant levels of displacement suggests that the unintended human and economic costs of aerial eradication should be explicitly considered and addressed by policy makers. The human and economic costs of displacement due to aerial eradication may only perpetuate the poverty and underdevelopment common to agricultural regions already most likely to grow coca, creating an on-going cycle and pattern of transient coca cultivation. At a minimum, aerial eradication policies should be complemented

[70] Michael Tomz, Jason Wittenberg and Gary King, 'CLARIFY: Software for Interpreting and Presenting Statistical Results', Version 2.0, Cambridge, MA: Harvard University, 1 June 2001.

with sufficient funding to mitigate the human and economic costs and reduce the likelihood that eradication will continue to generate a sub-national balloon-effect.

Second, the results create a dilemma for policy makers hoping to reduce coca cultivation by reducing localised poverty and marginalisation. Because coca cultivation is concentrated in areas of moderate poverty and is seldom found in areas of extremely low or high poverty, efforts to address extreme poverty might have the unintended consequence of facilitating coca cultivation. The answer is not to abandon areas in extreme poverty, but to ensure that poverty alleviation programs simultaneously address the other factors that make coca cultivation attractive. For example, poverty alleviation programs should simultaneously address local public infrastructure and access to agricultural markets to reduce the likelihood that extreme poverty is replaced by coca cultivation.

Finally, the results suggest that coca cultivation thrives in economically underdeveloped, agricultural regions where residents have the means to partake in agricultural endeavours but lack access to legal markets due to poor public infrastructure and a weak state presence. The policy implication is that establishing strong local state capacity, reducing corruption through improved accountability and transparency, and investing in public infrastructure to support local access to legal agricultural markets should all help reduce coca cultivation. Unfortunately, these are all policies that have been underdeveloped or under-funded as part of Plan Colombia. Securing long-term reductions in coca cultivation will require the strategic yet localised funding, development and oversight of public and market infrastructures that emphasise both accessibility and sustained viability. Given Colombia's large expanse of relatively ungoverned territory, institutionalised solutions that foster government and communal accountability are clearly needed, and Colombia's nascent efforts in this terrain warrant internationalised analytical, financial and logistical attention. Policy formulators should acknowledge that the surest investments are not necessarily those of immediate returns.

This is the principle argument of alternative development proponents who seek increased funding for localised projects (UNODC, 2005). During 1999–2007, US$350 million was allocated to national level alternative development activities, and the annual alternative development activities implemented at the municipal and departmental levels increased from US$3 million in 2000 to US$78 million in 2004.[71] These funding levels are

[71] See UNODC, *Colombia Coca Survey* (2005). UNODC was contacted for this study, and annual department-level allocation or receipt of alternative development funds have yet to be compiled.

small relative to funding for military and eradication efforts. Increasing emphasis on alternative development programmes to combat coca cultivation acknowledges the shortcomings of forced eradication as a long-term policy. However, the inconsistent development, implementation, oversight and dispersal of funds for alternative development projects since Plan Colombia's commencement has severely impeded both their potential effectiveness and the availability of data on funding dispersal and project results.[72] Though the effect of alternative development projects on local and national coca cultivation levels may be difficult to monitor because their implementation and results take longer to mature, our findings suggest that such programmes, by addressing the structural sources of coca cultivation, may have a longer lasting effect on cultivation in Colombia than short-term strategies to fumigate current cultivation.

[72] Ramírez Lemus, et al., 'Colombia: A Vicious Circle of Drugs and War'; Isacson, 'The US Military in the War on Drugs.'

Appendix: Jack-knife Test Results

Department	Actual avg. cultivation*	Model 1		Model 2	
		Predicted cultivation	Difference	Predicted cultivation	Difference
Atlántico	0.000	−13.386	13.386	−11.983	11.983
Casanare	0.000	−4.697	4.697	−6.729	6.729
Cesar	0.000	−2.423	2.423	−1.009	1.009
Huila	0.000	3.098	−3.098	8.634	−8.634
Quindio	0.000	16.092	−16.092	9.402	−9.402
Risaralda	0.000	−1.254	1.254	2.716	−2.716
San Andrés	0.000	−16.757	16.757	−15.473	15.473
Sucre	0.000	2.608	−2.608	−0.292	0.292
Tolima	0.000	−4.502	4.502	−2.728	2.728
Cundinamarca	0.007	−0.034	0.041	3.018	−3.011
Valle	0.017	−9.157	9.173	−8.919	8.936
Boyacá	0.018	−2.967	2.985	2.495	−2.478
Caldas	0.037	−7.734	7.771	−6.736	6.773
Santander	0.145	−4.205	4.351	−0.034	0.180
Magdalena	0.159	5.592	−5.433	10.192	−10.033
Chocó	0.207	9.668	−9.461	6.964	−6.756
Cordoba	0.232	−2.708	2.940	−4.891	5.123
Guajira	0.274	−2.741	3.016	−3.689	3.963
Cauca	0.344	7.210	−6.865	13.318	−12.973
Antioquia	0.363	−7.804	8.167	−5.857	6.220
Bolívar	0.845	−8.622	9.467	−8.268	9.114
N. Santander	1.673	−3.954	5.627	0.128	1.545
Nariño	1.876	−0.107	1.983	2.110	−0.234
Arauca	3.579	−8.013	11.592	−4.192	7.771
Amazonas	3.866	−1.128	4.995	3.425	0.441
Caquetá	4.952	−1.367	6.319	1.534	3.418
Meta	6.882	10.703	−3.821	16.917	−10.036
Guainía	9.087	56.494	−47.407	43.046	−33.959
Vaupés	9.210	22.996	−13.786	8.316	0.894
Putumayo	12.237	−2.003	14.240	24.804	−12.567
Vichada	22.054	27.515	−5.460	20.349	1.705
Guaviare	47.926	22.903	25.023	27.489	20.437
Average			1.414		0.059

Note: *Cultivation in km^2 per capita.