# Theory and Evidence…..

# Effectiveness of Anti-Drug Measures:

# Cocaine in Colombia

by

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# Effectiveness of Anti-Drug Measures: Cocaine in Colombia

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**ABSTRACT**

Colombia has maintained its position as the world leader in cocaine production over the past decade. In 2006, Colombia alone accounted for fifty percent of the world's cocaine production. Moreover, ninety percent of all cocaine that enters the United States is said to originate from Colombia, and consequently, the United States has spent over $6 billion on anti-drug programs aimed at reducing coca cultivation and cocaine production in Colombia. Despite these resources and initiatives, Colombia has been able to defend its position as the market leader. This paper will attempt to assess the effectiveness of the various anti-drug programs in Colombia. This analysis should prove to be both insightful and helpful to policymakers and government officials dedicated to decreasing coca cultivation and cocaine production in Colombia.

I would like to sincerely thank my thesis advisor, Professor Wolfenzon, for his support and guidance throughout this project. This thesis would not have been possible without his commitment and generous help. I would also like to thank Professor Subrahmanyam for dedicating his time to creating a program that fosters higher level thinking. And lastly, I would like to thank the Stern School of Business at New York University for its support of this research effort.

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# Introduction

The Andean Region in South America has maintained its position as the world leader in coca plant cultivation and cocaine production since the 1980s. In 2006, Colombia was responsible for fifty percent of the world's coca cultivation, followed by Peru and Bolivia responsible for thirty-three percent and eighteen percent, respectively.[1] While there is a marginal level of spillover coca cultivation in the neighboring countries of Ecuador and Venezuela, there is no significant coca cultivation outside the Andean Region, and thus, the Andean Region is thought to be the exclusive cultivator of coca plant.[2]

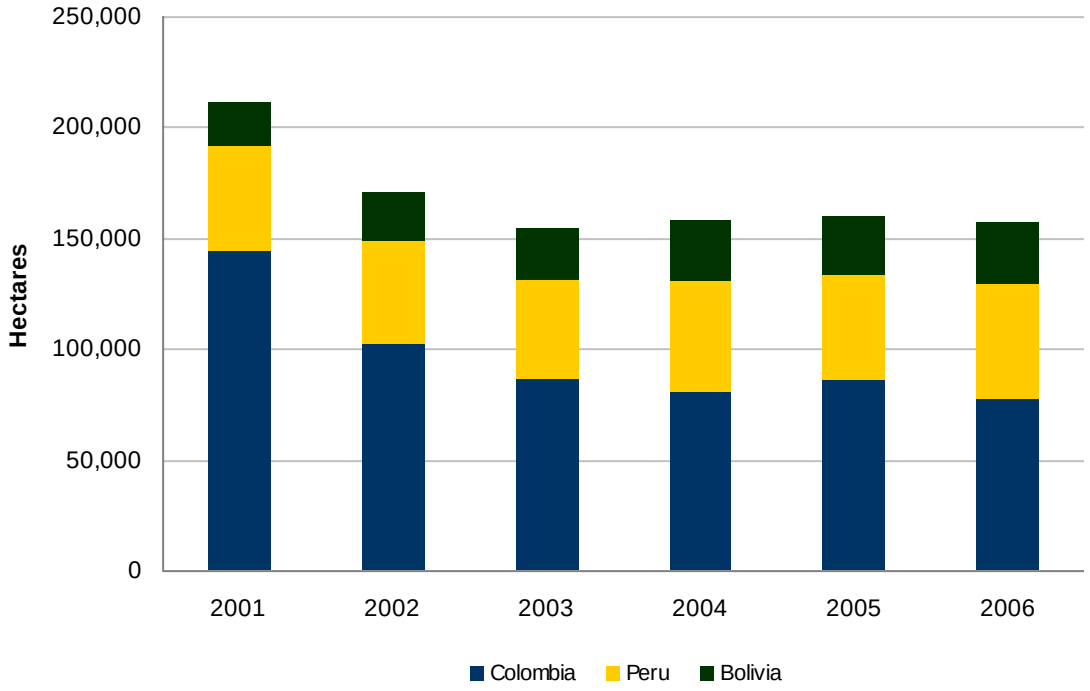
Currently, North America and Europe are the two primary markets for cocaine. In the most recent publication of the *World Drug Report*, it was estimated that there are 6,363,000 cocaine users in North America, which accounts for 46% of all cocaine users in the world.[3] The Drug Enforcement Administration reported that as of January 2007 the average price of a gram of pure cocaine is $96 in the United States.[4] Despite its high cost, cocaine remains to be the second most abused drug in the United States, with approximately 1.7 million abusers.[5]

Approximately ninety percent of all cocaine that enters the United States originates in Colombia.[6] As a result, the United States has allocated a significant amount of money to support anti-drug measures in Colombia. According to a recent Economist Intelligence Unit Country Report on Colombia, the United States has spent approximately $6 billion between 1999 and

[1] *Colombia Coca Cultivation Survey*. 2007. United Nations: Office on Drugs and Crime. www.unodc.org, pg 7.
[2] *World Drug Report.* 2007. United Nations: Office on Drugs and Crime. www.unodc.org, pg 65.
[3] Ibid.
[4] Klein, Allison and Clarence Williams. "In D.C., Price of Cocaine Soars as Supply Declines." 9 Nov. 2007. *Washington Post.*
[5] *2006 National Survey on Drug Use and Health: National Findings*. 2007. Department of Health and Human Services: SAMHSA, Office of Applied Studies. <http://oas.samhsa.gov/nsduh/2k6nsduh/2k6results.pdf>.
[6] United States. International Office of National Drug Control Policy. Targeting Cocaine At the Source. 8 April 2008. <http://www.whitehousedrugpolicy.gov/publications/international/factsht/target_cocaine_src.html>.

2006 to help "fund the equipment of troops involved in the aerial spraying of coca crops and anti-insurgency operations" (Thompson 11).

*Graph 1: Coca Cultivation in the Andean Region (2001-2006)*

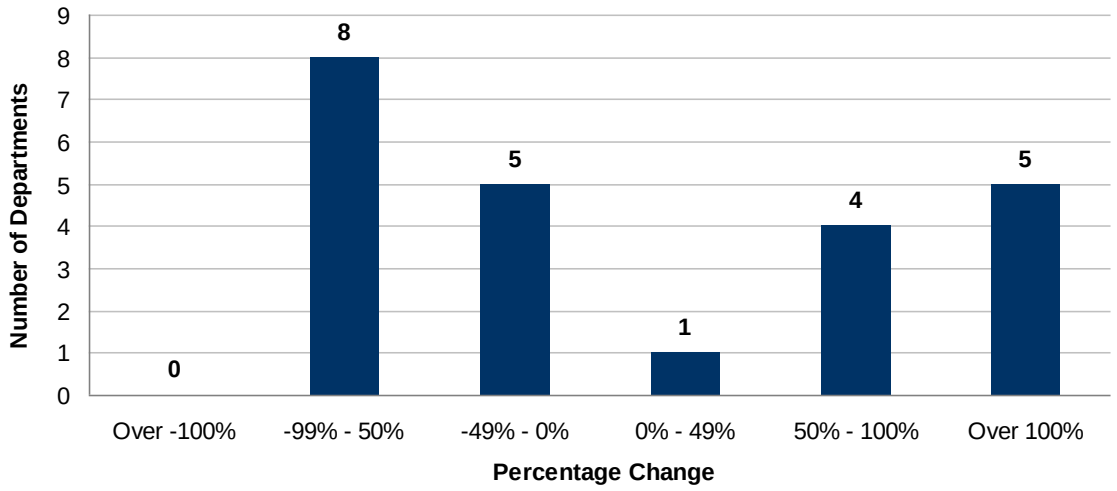



*Source: Colombia Coca Cultivation Survey.* 2007. United Nations: Office on Drugs and Crime. www.unodc.org, pg 17.

Despite these resources, overall coca cultivation has actually stabilized in recent years, which is illustrated above in Graph 1. The graph demonstrates that while there was some initial decrease in cultivation in both the Andean Region and in Colombia between 2001 and 2003, cultivation has actually leveled off over the past couple of years. It, therefore, appears that the anti-drug programs are proving to be ineffective in Colombia. In this paper, we will measure the effectiveness of the various anti-drug methods targeted at reducing coca cultivation and cocaine production in Colombia. Our analysis will highlight which anti-drug measures should be further invested in and which should be abandoned, allowing Colombia to better utilize its resources to effectively reduce coca cultivation and cocaine production.

As demonstrated in Graph 1, there is little variation in the data on Colombia. If, however, we look below at Graph 2, we see that there is substantial variation within each department. Graph 2 illustrates how varied changes in coca cultivation are by department throughout Colombia. For example, there are five departments who have experienced an increase of over a hundred percent between 2001 and 2006, and there are another eight departments who have experienced quite the opposite with a decrease of over fifty percent in cultivation levels. By using the within department variation, our analysis will be less likely to be skewed by outside factors.

*Graph 2: Percentage Change in Coca Cultivation by Department (2001-2006)*




*Source: Colombia Coca Cultivation Survey.* 2007. United Nations: Office on Drugs and Crime. www.unodc.org, pg 13

It is important to assess the effectiveness of the various anti-drug measures employed in Colombia for three primary reasons, all of which have been briefly highlighted already. First, the United States spends a significant amount of its own resources to reduce coca cultivation in Colombia. Secondly, Colombia is responsible for 50% of the world's coca cultivation, and for approximately 90% of all cocaine that enters the United States. Finally, cocaine usage in North America accounts for 46% of the world's usage. As a result, this subject is not only of importance but also of relevance. Considering how prevalent cocaine use is the United States

makes it crucial that the money spent on the anti-drug measures in Colombia is used effectively. If it is not, Colombia will remain the market leader, and cocaine use will continue to be a problem in the United States despite how much money is allocated to the anti-drug programs.

## Cocaine Production

Before we begin our discussion about the effectiveness of the anti-drug measures used in Colombia, it is important to understand the process through which cocaine is extracted from the coca leaves.

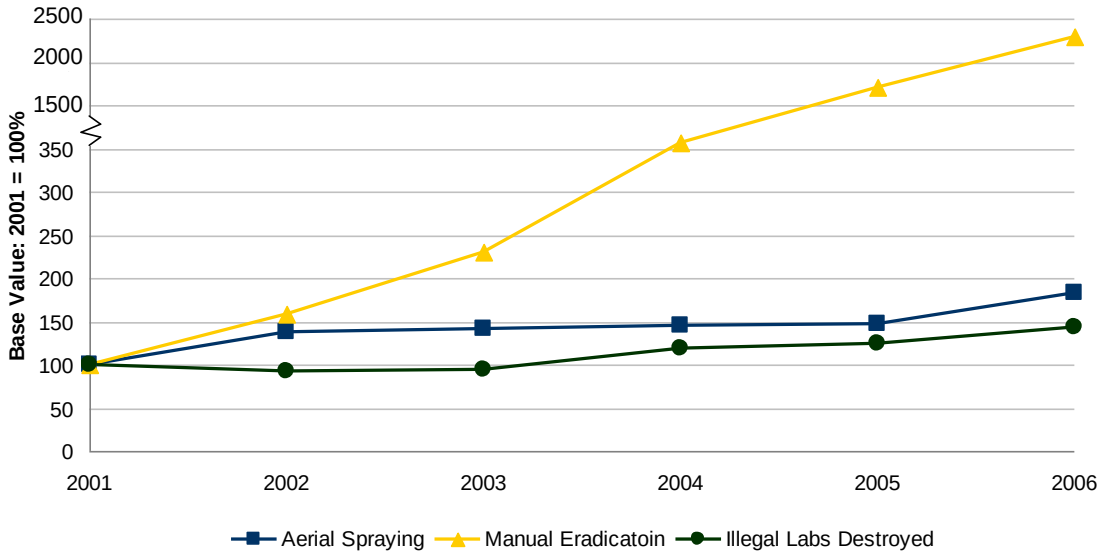
Farmers begin by growing the coca plant. Once the plant has matured, the farmer has the option to either sell the coca leaves, or to process the leaves into a coca paste or base. As of 2006, thirty-four percent of Colombian farmers did not process their coca leaves into a paste or base. These farmers were responsible for 25% of the total coca leaf cultivation. Approximately 35% of farmers processed the coca leaves into a coca paste by using sulfuric acid and combustibles to transform the coca leaves into a cocaine sulfate, a form of coca paste. These farmers represented 26% of the total coca leaf cultivation in 2006. Finally, approximately 31% of farmers chose to process their coca leaves into a cocaine base by dissolving the cocaine sulphate in an acid and then adding an oxidant agent followed by a base. The substance was then precipitated and filtered, and these farmers accounted for 49% of the total coca leaf cultivation. Once these steps are completed, farmers must sell the cocaine base to a third party, who will then process the cocaine base into cocaine hydrochloride in a clandestine laboratories. According to the estimates of the United Nations Office on Drugs and Crime, on average, this process yields approximately 7.4 kilograms of pure cocaine per hectare of coca plant.[7]

[7] *Colombia Coca Cultivation Survey*. 2007. United Nations: Office on Drugs and Crime. www.unodc.org, pg 39.

## Anti-Drug Measures in Colombia

Next, it is important to understand the range of anti-drug measures that are currently being employed in Colombia to reduce coca cultivation and cocaine production. We can classify the various methods into two primary categories: military and police assistance programs and economic and social assistance programs. The military and police assistance programs include aerial spraying, forced manual eradication, destroying illegal laboratories and seizing illegal drugs. The economic and social assistance programs, on the other hand, include alternative development products, forest management programs and the Forest Warden Families program. Originally, we planned to conduct an extensive analysis on both of these segments, but due to the lack of information, our analysis is focused solely on military and police assistance programs, with the exception of seizures. As such, the primary focus of this paper is to analyze the effectiveness of aerial spraying, forced manual eradication and destroying illegal laboratories.

*Graph 3: Anti-Drug Measures (2001-2006)*




Source: *Colombia Coca Cultivation Survey.* 2007. United Nations: Office on Drugs and Crime. www.unodc.org,

Graph 3, above, illustrates how each anti-drug measure has preformed from 2001 to 2006 relative to each other. As can be seen, the largest increase has been in the use of manual

eradication as an anti-drug measure. While the use of aerial spraying and the act of destroying illegal labs has increased throughout the years, it has been modest when compared to that of manual eradication. Even though efforts behind all three methods have increased significantly in recent years, they have only been able to stabilize coca cultivation in Colombia, at best.

## *Aerial Spraying*

Aerial spraying is a process through which a chemical mixture is released over a field by an aircraft. The chemical mixture is designed to destroy the leaves of the coca plan. The roots and soil, however, are left unharmed. As a result, farmers can prune the bush at about one feet above the ground, which yields a renewal bush in approximately six to eight months. If there is heavy rain or if the farmer washes the coca plants immediately after the spraying, the farmer can reduce the impact of the chemical mixture, which makes crop recovery easier.[8]

Farmers have already begun to take other necessary steps to reduce the effectiveness of aerial spraying. Amongst these steps include, planting coca bushes interspersed with other plants, reducing the size of fields, moving further into the eastern departments of Colombia, cycling coca crops with legal crops on the same field, pruning and replanting seedlings and protecting the leaves with other chemical substances.[9,10] We may see the impact of these measures on our results, as aerial spraying is becoming more and more difficult.

## *Manual Eradication*

The Presidential Agency for Social Action oversees the forced manual eradication program, in which coca plants are manually uprooted by a group of people. The Mobile Eradication Group, which consists of former illegal armed group members and farmers, is

[8] *Colombia Coca Cultivation Survey*. 2007. United Nations: Office on Drugs and Crime. www.unodc.org, pg 76
[9] Ibid.
[10] United States. International Office of National Drug Control Policy. Targeting Cocaine At the Source. 8 April 2008. <http://www.whitehousedrugpolicy.gov/publications/international/factsht/target_cocaine_src.html>.

responsible for executing the manual eradication of illicit crops. They are often aided by the Anti-Narcotics Police and the army. Moreover, the new "Everybody Against Coca" campaign now requires police departments throughout the country to assist in the manual eradication of illicit crops as well.[11] With manual eradication, farmers must overcome significant costs if they want to replant the destroyed coca plants. It takes approximately eight months between replanting and the first harvest, and there is low productivity during the initial stages. An analysis conducted by the Mobile Eradication Group concluded that of the total area eradicated, 62% of the land was without replanting, 11% was replanted and 27% was unidentifiable.[12] Therefore, it is evident that these factors act to deter farmers from replanting the destroyed crop.[13]

### *Destroying Illegal Labs*

As previously mentioned, coca base is not processed into cocaine hydrochloride at the farms, but instead, at clandestine laboratories located throughout the country.[14] The Colombian Government uses its army and police force to locate and destroy the clandestine laboratories, an effort that is led by the National Narcotics Bureau in Colombia. The destruction of the illegal labs helps prevent cocaine from exiting the country and entering markets such as the United States. It is very difficult to locate these labs because of their small size and tendency to be located deep in the forests. Many times, however, labs are strategically located so that the cocaine can be easily shipped to its final destination, which can help government officials locate these labs more easily.

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[11] *Colombia Coca Cultivation Survey.* 2007. United Nations: Office on Drugs and Crime. www.unodc.org, pg 71.
[12] Ibid.
[13] Ibid.
[14] Ibid.

# Hypothesis

We saw earlier that coca cultivation has leveled off in recent years, and as a result, we predict that some of the anti-drug measures in Colombia may be less effective than others.

## *Aerial Spraying*

We saw in Graph 3 that the number of hectares destroyed through aerial spraying has almost doubled between 2001 and 2006. We also know, however, that it is becoming more and more difficult to successfully destroy coca plants through aerial spraying because farmers are taking preventive measures to protect their coca plants. Despite these factors, we still predict that an increase in the total hectares of coca plant destroyed by aerial spraying, will lead to a decrease in coca cultivation. We predict, however, that the reduction in coca cultivation will be far less than that of the other anti-drug measures.

## *Manual Eradication*

When coca plants are manually uprooted, farmers must face serious costs to replant the coca plants. As a result, many farmers choose not to replant the coca plant, which reduces total coca cultivation throughout the various departments in Colombia. We, therefore, predict that an increase in the total hectares destroyed through manual eradication will reduce the total hectares of coca plant in each department. We also believe that manual eradication will be more effective than aerial spraying and possibly even more effective than destroying illegal labs.

## *Destroying Illegal Labs*

Destroying illegal labs prevents cocaine from leaving the country and entering the market place. If there is an increase in the number of labs that are destroyed in a particular region, there will be fewer places for farmers to sell their coca leaves, coca paste or cocaine base. If farmers do not have someone to whom they can sell their products, they will stop growing the coca plant.

Most times, farmers prefer to sell their products to someone who is nearby to reduce the likelihood of it being seized by the police. As a result, we predict that an increase in the number of labs destroyed in a department will decrease the total hectares of coca plant. Again, we assume that destroying illegal lab will be more effective than aerial spraying but probably less effective than manual eradication.

## Data and Sources

The United Nations Office on Drugs and Crime publishes extensive reports about cocaine in Colombia. While reports date back to 2001, only the most recent reports include data on a per department basis. As a result, we chose to focus our analysis on the anti-drug measures we previously discussed over a time period of 2001 to 2006.

As can be seen, we have chosen to obtain the majority of our data from the United Nations Office on Drugs and Crime publications. We did this for two primary reasons. First, these particular publications were the most comprehensive, and secondly, relying on one source allows us to ensure a level of consistency in our data. To elaborate on the latter point, organizations that monitor coca cultivation in Colombia have different methodologies, and as a result, varying organizations will report different levels of cultivation. By choosing one organization, we were able to avoid this discrepancy in reporting.

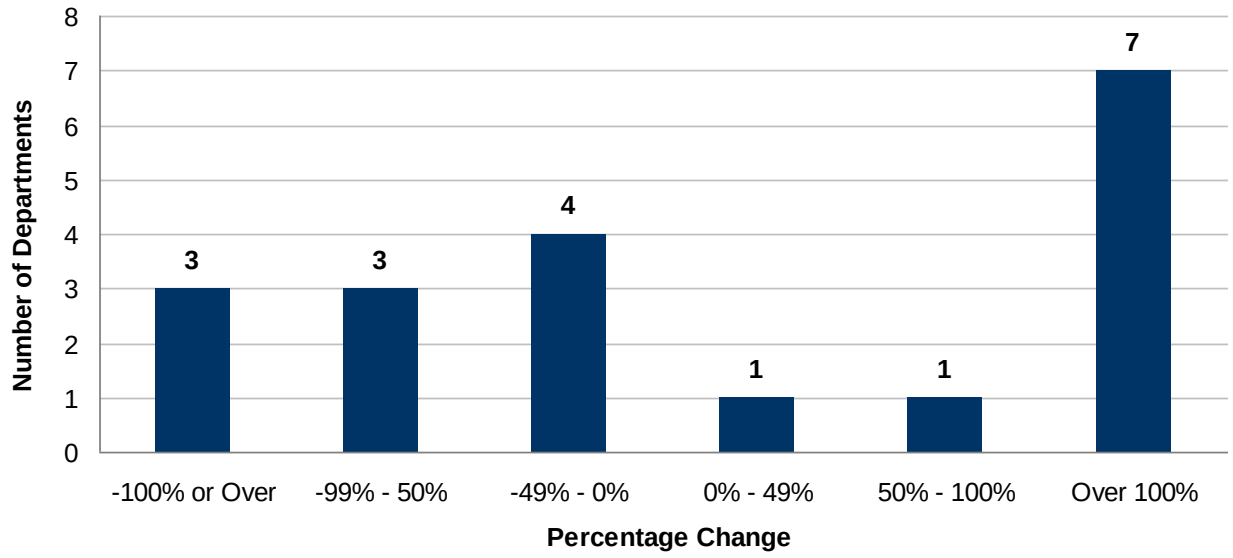
### *Coca Cultivation*

The United Nations Office on Drugs and Crime reports that there are 23 departments in which coca cultivation is present. As a result, we collected data for the cultivation levels for each of these 23 departments from 2001 to 2006. The data was extracted from the Colombia Coca Cultivation Surveys for 2004, 2005 and 2006.

## *Aerial Spraying*

To analyze the effectiveness of aerial spraying, we looked at data from 2001 to 2006 on a per department basis. This data was included in great detail in the Colombia Coca Cultivation Survey for 2005 and 2006. Aerial spraying is only conduced in 19 departments over varying time periods between 2001 and 2006. As a result, we had a total of 81 observations.

*Graph4: Percentage Change in Aerial Spraying by Department (2001-2006)**




*Source: Colombia Coca Cultivation Survey.* 2007. United Nations: Office on Drugs and Crime. www.unodc.org, pg 13
** Of the original 23 departments that engage in coca cultivation, only 19 departments have aerial spraying. Excluded departments: Choco, Guainia, Amazonas and Valle del Cauca.*

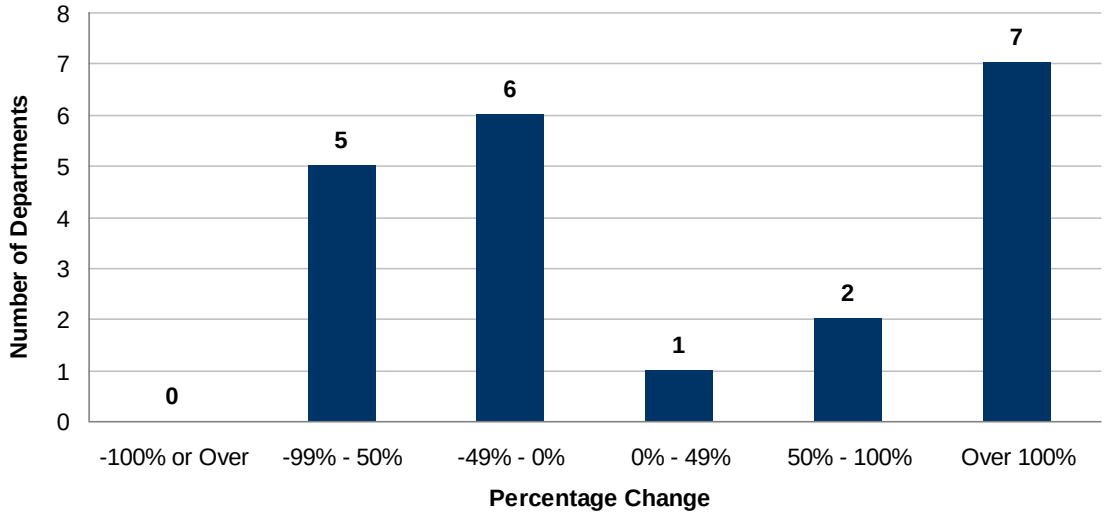
As seen above in Graph 4, aerial spraying efforts vary significantly from department to department. Given the variation in this data, it will be interesting to see the relationship between the coca cultivation and the variation in aerial spraying efforts.

## *Manual Eradication*

We experienced some difficultly in collecting the necessary data for the manual eradication efforts on a per department basis. While data is available for manual eradication efforts in Colombia as a whole from 2001 to 2006, departmental data is only available for 2005 and 2006. This data was once again extracted from the Colombia Coca Cultivation Survey for

2005 and 2006. This unfortunately yielded a much smaller data set than we had originally wanted. There are 21 departments in which there is an active manual eradication effort. There were only two observations per department, however, and as a result we only had a total of 42 observations for this data set.

*Graph 5: Percentage Change in Manual Eradication by Department (2005-2006)**




*Source: Colombia Coca Cultivation Survey.* 2007. United Nations: Office on Drugs and Crime. www.unodc.org, pg 71
**Of the original 23 departments that engage in coca cultivation, only 22 departments have aerial spraying. Guainia was excluded from our analysis.*

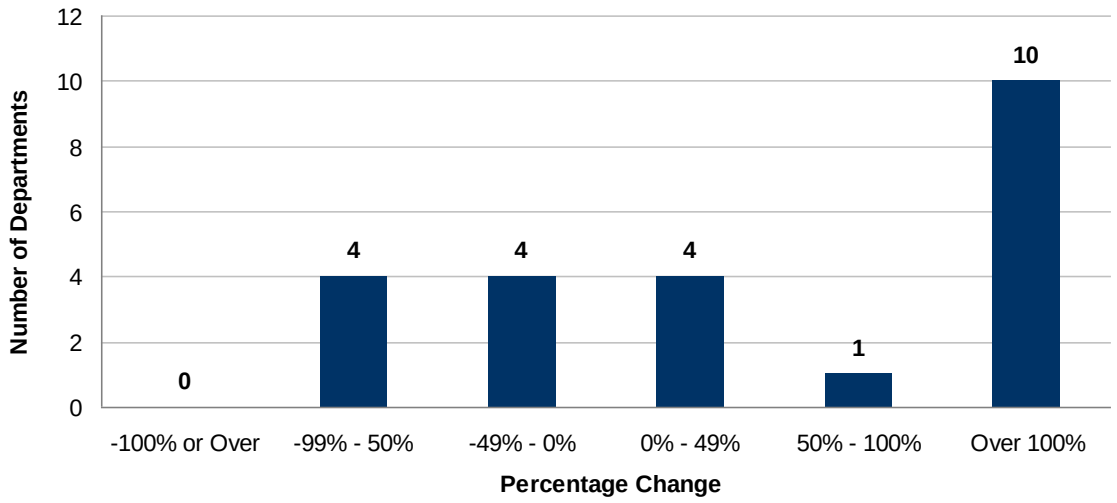
Despite the lack of data, Graph 5, above, clearly demonstrates that there still exists a vast array of variation in the efforts across the country. Again it will be interesting to see what kind of relationship exists between the cultivation levels as a function of the manual eradication efforts.

## *Destroying Illegal Labs*

We once again looked at data spanning from 2001 to 2006 on a per department basis to establish the effectiveness of destroying illegal labs. Like the other data sets, this data was extracted from the 2005 and 2006 Colombia Coca Cultivation Surveys. In this data set, illegal labs were discovered in all 23 departments. Like the aerial spraying data set, however, labs were

not discovered for six consecutive years in each department, but rather over varying time periods. As a result, we had a total of 118 observations.

*Graph 6: Percentage Change Illegal Labs Destroyed by Department (2001-2006)*




*Source: Colombia Coca Cultivation Survey.* 2007. United Nations: Office on Drugs and Crime. www.unodc.org, pg 79

Once again, Graph 6 highlights that there is great variation in the efforts in each department between 2001 and 2006. This variation will once again make it interesting to see the relationship between total coca cultivation and the number of illegal labs that are destroyed.

## Findings from Regressions

### *Dependent Variable: Cultivation Level*

In our first set of regressions, we attempted to determine the relationship between cultivation levels as a function of aerial spraying, manual eradication and destroyed illegal labs in a series of three separate regressions. The formula for each regression was $C = \alpha + \beta AS$, $C = \alpha + \beta ME$ and $C = \alpha + \beta IL$, respectively. In these regressions, *C* represents total hectares of coca plant cultivated in a department for a given year. As such, each department can have up to six observations, one for each year from 2001 to 2006, or as little as two observations. In the first formula, *AS* represents total hectares of coca plant destroyed by aerial spraying in a department

for a given year. In the second formula, *ME* represents total hectares of coca plant destroyed through manual eradication in a department for a given year. Lastly, in the third formula, *IL* represents the number of illegal labs discovered and destroyed in a department for a given year.

It is important to remember that each of these data sets vary in size. For example, there are only 19 departments in which aerial spraying takes place. Moreover, because efforts vary on a year-to-year basis in departments, there are only a total of 81 observations. As such, we will only use the corresponding 81 observations of coca cultivation when we complete our analysis. The same logic applies for our analysis for the destruction of illegal labs, in which we have 118 observations. Moreover, since we only consider the 21 departments with manual eradication efforts over a period of two years from 2005 to 2006, we will only use the 42 corresponding observations for coca cultivation.

*Table 1* **Dependent Variable: Cultivation Levels**

| | 1 | 2 | 3 |
|---|---|---|---|
| **Constant**<br>**(t-stat)** | 3372.4<br>(3.90) | 1561.7<br>(1.71) | 2242.7<br>(3.47) |
| **Aerial Spraying**<br>**(t-stat)** | 0.30655<br>(6.04)*** | - | - |
| **Manual Eradication**<br>**(t-stat)** | - | 1.3171<br>(3.51)*** | - |
| **Illegal Labs Destroyed**<br>**(t-stat)** | - | - | 28.171<br>(6.77)*** |
| **Number of Observations** | 81 | 42 | 118 |
| **$R^2$** | 31.60% | 23.50% | 28.30% |

*Note: *, **, or *** denotes significance at the 10, 5, and 1% levels, respectively.*

As seen above, Table 1 highlights the results of these regressions. Each of three regressions yielded a positive coefficient, which implies that an increase in aerial spraying, manual eradication or destroying illegal labs, leads to an increase in coca cultivation, which contradicts our original thoughts. We can attempt to explain this relationship by assuming that anti-drug measures are increased in departments where there is first an increase in coca cultivation. As a result, the causality is reversed, and suggests that an increase in cultivation

levels actually leads to an increase in aerial spraying, manual eradication, or the destruction of illegal labs.

### *Dependent Variable: Cultivation Level with Dummy Variables*

In order to correct for the reversed causality, we ran another set of regressions in which we used the same data set as the previous regression set, but this time we assigned dummy variables to each of the departments. By doing this, we were able to take care of the fact that some departments have higher cultivation levels than others. By using dummy variables, we can absorb the affects that are constant throughout time. For example, dummy variables would eliminate the impact of geographical differences between departments, which may affect cultivation levels in any given department.

*Table 2* **Dependent Variable: Cultivation Levels**

| | 1 | 2 | 3 |
|---|---|---|---|
| **Constant** | 84.0 | 362.9 | -893 |
| **(t-stat)** | (0.02) | (0.41) | (-0.39) |
| **Aerial Spraying** | 0.08604 | - | - |
| **(t-stat)** | (1.30) | | |
| **Manual Eradication** | - | -0.2801 | - |
| **(t-stat)** | | (-1.32) | |
| **Illegal Labs Destroyed** | - | - | 20.183 |
| **(t-stat)** | | | (5.26)*** |
| **Department Dummies** | Yes | Yes | Yes |
| **Number of Observations** | 81 | 42 | 118 |
| **$R^2$** | 61.00% | 96.70% | 73.20% |

*Note: *, **, or *** denotes significance at the 10, 5, and 1% levels, respectively.*

Table 2, which is shown above, highlights the results from this set of regressions. As can be seen, the regression for aerial spraying yields a much lower value for its coefficient, but it is not yet negative. In actuality, this value is indistinguishable from zero and is statistically insignificant. For manual eradication, we see that the coefficient is now negative. This now shows that as manual eradication efforts are increased, there will be less coca cultivation. Despite the presence of this relationship, it is statistically insignificant as well. Finally, much

like aerial spraying, it appears that while the coefficient decreased for the destruction of illegal labs, it still remained largely positive.

### *Dependent Variable: Change in Cultivation Level*

We also attempted to correct for the reversal of causality by running a regression for the change in cultivation level as a function of average aerial spraying, manual eradication and the destruction of illegal labs. In this set of regressions, each formula read $\Delta C = \alpha + \beta AS_{avg}$, $\Delta C = \alpha + \beta ME_{avg}$ and $\Delta C = \alpha + \beta IL_{avg}$. In this case, $\Delta C$ represents the change in total hectares of coca plant in a department between the first year in which the coca plant was cultivated and the most recent year, bounding the years to 2001 and 2006. In the first formula, $AS_{avg}$ represents the average amount of hectares destroyed by aerial spraying in a department between 2001 and 2006. In the second formula, $ME_{avg}$ represents the average amount of hectares destroyed through manual eradication in a department between 2005 and 2006. And finally, in the last formula, $IL_{avg}$ represents the average number of illegal labs discovered and destroyed in a department between 2001 and 2006. Average values are calculated by taking the sum of how many hectares or labs were destroyed and dividing it by the appropriate number of years. By using the change in coca cultivation, we are able to control for the departments in which there may be more or less cultivation, which is similar to using dummy variables.

The results of these regressions are presented in Table 3 on the next page. We see that the regression related to aerial spraying yielded a negative coefficient, which means that as average aerial spraying increases, there is a decrease in the change in cultivation levels. This is significant at the 10% level. For manual eradication, we still have a positive coefficient, which is statistically insignificant. This could be contributed to the fact that the change in cultivation level was calculated over a period of only two years, and the average number of hectares

destroyed was also over a period of only two years. Finally, we see that we get a negative coefficient for the average number of illegal labs destroyed. Thus, we know that an increase in the average number of labs that are destroyed will lead to a decrease in the change of cultivation levels, which is also significant at the 10% level.

*Table 3* **Dependent Variable: Change in Cultivation Levels**

| | 1 | 2 | 3 |
|---|---|---|---|
| **Constant** | -206 | -716 | -198 |
| **(t-stat)** | (-0.08) | (-1.19) | (-0.08) |
| **Average Aerial Spraying** | -0.3845* | - | - |
| **(t-stat)** | (-1.87) | | |
| **Average Manual Eradication** | - | 0.2031 | - |
| **(t-stat)** | | (0.76) | |
| **Average Illegal Labs Destroyed** | - | - | -31.57* |
| **(t-stat)** | | | (-1.54) |
| **Number of Observations** | 19 | 21 | 23 |
| **$R^2$** | 17.00% | 3.00% | 10.20% |

*Note: *, **, or *** denotes significance at the 10, 5, and 1% levels, respectively.*

# Conclusion

## *Effectiveness of Anti-Drug Measures*

Despite our analysis, it is difficult to fully assert the effectiveness of each strategy. While many of our regressions proved to be of very little statistical significance, we saw that there was some sort of causal relationship between two sets of factors. First, there was a statistically significant relationship between the change in coca cultivation as a function of average aerial spraying, which dictated that increasing aerial spraying by one hectare, would reduce coca cultivation by 0.385 hectares. Second, we saw a statistically significant relationship between the change in coca cultivation as a function of average number of illegal labs destroyed. In this case, we saw that destroying one additional illegal lab, would reduce coca cultivation by 31.6 hectares. Unfortunately, we could not assess the effectiveness of the manual eradication efforts as the regressions proved to be of little or no statistical significance. From our research, we can assert

that destroying illegal labs is more effective than aerial spraying at reducing coca cultivation. For aerial spraying to have the same impact as destroying illegal labs, we would have to increase aerial spraying efforts by 82 hectares, which would also result in a reduction of 31.6 hectares. As a result, our initial hypothesis was correct in assuming that destroying illegal labs would be more effective than aerial spraying.

We should, however, also consider the costs of each program as well. Our studies indicate that increasing aerials spraying efforts by 82 hectares will have the same impact on coca cultivation as destroying one illegal lab. Given this information, we should consider what the cost of destroying one illegal lab is in relation to destroying 82 hectares through aerial spraying. If it costs more money to discover an illegal lab, aerial spraying may prove to be a more cost effective anti-drug measure. Unfortunately, we were unable to find sufficient amount of data regarding the cost of these programs on a department basis, and therefore, we could not make these conclusions.

### *Further Thoughts*

The United States is dedicated to allocating money to the various anti-drug measures in Colombia because cocaine poses a serious threat to the well-being of our nation. As a result, like we briefly mentioned already, this study should be extended to include the cost of each program. This in turn will allow us to better determine which anti-drug measure is most cost effective, allowing us to make recommendations about which methods to pursue and which to abandon. Moreover, we also believe that a subsequent study should consider which programs act as permanent deterrents and which act as temporary deterrents. What's more is that it would be interesting to include all of the anti-drug measures that we mentioned earlier in this paper to fully understand the scope of the anti-drug measures being employed in Colombia.

Recent trends also show that as Colombia's share in coca cultivation decreases gradually, Bolivia and Peru are also slowing increasing their share. As a result, I believe that a similar study to this one should be conducted in regards to Bolivia and Peru, as well. This new study paired with what we have seen in Colombia could substantially help policymakers and government officials in these other two countries to also enact programs that are cost effective.

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