

MASTER'S THESIS
INTERNATIONAL ADMINISTRATION
AND GLOBAL GOVERNANCE

The Impact of Coca Supply Reduction Efforts on Violence in Colombia

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Abstract

Cocaine remains one of the most problematic drugs in today's world. It has been associated with numerous negative health effects, as well as drug-related violence and other undesirable impacts. The "*war on cocaine*" encompasses a variety of measures to reduce its supply, but more knowledge is needed to conclude which measures are effective. This study researches the link between coca supply reduction and violence in Colombia. Is the reduction of coca plant increasing the level of violence in Colombia, or conversely, does less coca leaf mean less violence? This study analyses the data on coca cultivation, as well as homicide rates and kidnappings in 23 Colombian departments between 2004 - 2011 using panel data analysis. The analysis found a weak and statistically insignificant relationship between the variables "*area under coca cultivation*" and two variables representing violence level, i.e. "*homicide rate*" and "*kidnapping rate*". Therefore, the study concludes that the supply reduction effort should not be presented as a tool to reduce the violence in coca growing regions.

Keywords: Colombia, cocaine, supply reduction, effect of supply reduction on violence, violence

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1. Introduction

1.1. Introduction to this thesis

For centuries, drug consumption has been a controversial issue. Currently the legal drug business is a well-controlled area, however when it comes to the illicit drug trade, the situation is more serious. Only a few policies targeting the illegal business have been effective, resulting in a minor number of countries that have managed to achieve a significant reduction in drug consumption or production.

This study looks into the issue of supply reduction, i.e. policies that focus in lowering the supply and availability of the drug. Cocaine is extracted from the leaves of the coca bush plant, which is currently cultivated solely in the Andean region. Taking into account the concentration of the cocaine supply in this area, the most prominent reduction methods are as follows: eradication, interdiction and alternative development. In particular this thesis aims to investigate the effect of supply reduction in Colombia on local levels of violence.

The analysis found a weak relationship between the area under coca cultivation and the number of homicides and kidnappings. The analysis considered 3 different models. The best model (measured by its $-2\log$ likelihood value) was in all cases linear model with random slope and random intercept for each region. However most of the results were statistically insignificant, therefore the conclusion suggests that a decrease in violence may not be achieved through cocaine supply reduction programs only. The link is evidently very complex and more research needs to be undertaken in order to learn about the most efficient strategy.

Disposition

This thesis is divided into six chapters. The first chapter briefly introduces the study and presents the research aim and question. The second chapter will elaborate on the international drug control system, its development, as well as the history of cocaine and supply reduction programs. The third chapter presents the main theories, academic research, as well as policy-makers response relevant to the issue. The fourth

chapter will describe the concepts and data used for the analysis that is presented in chapter five. The final chapter will draw a final conclusion.

1.2. Research aim and question

The aim of this study is to research the link between reduction efforts in the cocaine supply market and violence levels in Colombia, a major cocaine producing country. According to the World Drug Report 2012, coca leaf cultivation in Colombia fell from 144 800 hectares in 2001 to about a third, 57 000 hectares in 2010, United Nations Office on Drugs and Crime (2012). Concerning such a rapid decrease, there maybe an observable impact on violence levels in Colombia.

Reduction in Colombian coca cultivation was achieved by means of intense aerial spraying, manual eradication, as well as alternative development programs and various law enforcement measures. In 2010 alone, an area of 145 000 hectares was fumigated or manually eradicated¹. Net area affected by coca cultivation in Colombia in 2010 was 62 000 hectares (adjusted for small fields) and a large part of the area is now subject to law enforcement pressure. However, the report does not discuss potential consequences of such reduction efforts that may have a negative, or a positive impact on Colombia's violence levels.

This study looks at the consequences that can be associated with cocaine supply reduction programs recently implemented in Colombia, particularly on violence. The study will focus on the relationship between coca reduction and local levels of homicide rates and kidnapping rates in Colombia.

The relationship between cocaine supply and related violence is a well-established link. Colombian violent organisations are known to use cocaine profits to exert violent pressure to support their activities. Therefore, this study aims to investigate whether the violent groups respond to lowering coca-related income by increasing

¹ The number is higher than the total area where coca is being cultivated, as some areas need to be fumigated more than once.

² Estimated total income derived from cocaine industry in 2009 is 85 billion USD

violence, or less profits from drugs weakens the capacity of armed organisations to violate.

The research takes into account the effects on Colombia only. It abstracts from potential impact of supply reduction on the country of consumption, transition, or any other participating state.

The research question serves the purpose to answer whether supply reduction programs in Colombia were beneficial to the country, or not, in terms of bringing down the violence. The research question is: "*Can the reduction in coca cultivation be interpreted as successful in terms of stabilizing the security situation in Colombia?*"

2. Background

The following chapter will present the current situation as well as historical developments in the area studied. At the beginning of this chapter, preconditions for emergence as well as benefits and negatives of the international drug control system will be discussed. The second section will introduce the three main conventions making up today's international drug control system. Thirdly, brief history of cocaine and the economic characteristics, under which the cocaine market operates. The fourth subchapter will discuss supply reduction efforts in general, while the last section will follow with a presentation of recent supply reduction programmes in Colombia.

2.1. Emergence of International Drug Control System

Addictive substances, such as opium, cannabis or coca, have been known of and consumed over centuries. By the end of the 19th century drug trade had grown into a global problem and the international drug control system begun to emerge. Nevertheless, until now the drug market remains a lucrative, but problematic industry.

Two major trade and diplomatic disputes between China and the British Empire, called the Opium Wars, took place in the mid 19th century. Opium imports had devastating social and economic effects; resulted in currency outflow and in an

increasing number of opium addicts in some Asian countries, especially China. On the other side, many island countries and colonial powers derived large profits from the opium trade and were not willing to put any restrictions on the industry. The situation called for a solution that one country was not able to address by its own means. The first multilateral initiative to approach, the then already major global issue, was the Shanghai Commission. Four years later, in 1912, the first convention was signed in Hague and provided the foundations for an international drug control system.

Already the first convention from Hague created a dispute over how to deal with negative impacts of drug abuse. Reducing opium cultivation, promoted strongly by the USA, was opposed by producing countries, such as the UK, Russia and Persia. As a result, the first international conventions did not require supply reduction measures, but only a control of production.

Developments in the following years, especially the two world wars, overshadowed the drug issue. Little progress was made during this period. For instance, signatories of the Versailles Treaty were required to adhere to the Hague Convention, however, there was no significant event until 1961, when the Single Convention was signed. Within the following two decades the Convention on Psychotropic Substances in 1971 and the United Nations Convention against Illicit Traffic in Narcotic Drugs and Psychotropic Substances in 1988 were agreed on. These three agreements make up today's international drug control regime.

United Nations Office on Drugs and Crime (2008;b) considers the following achievements as a major successes of the international drug control system over its existence: (i) consensus on the drug control regime, (ii) development of normative instruments, (iii) establishment of international bodies, and (iv) curtailing of the licit drug trade. However the international drug control system produced some unintended consequences. These are (i) the creation of the black market, (ii) "*policy displacement*" driving resources away from other activities, especially public health, (iii) the "*balloon effect*" resulting in geographical movements of the drug problem, (iv) transitions of consumers to substances other than those under strict control and

(v) further marginalization of drug consumers, who often already come from marginalized groups of the society.

Currently, the international drug control system works well in illicit drug manufacturing, but the unintended illicit production and trafficking is now making up most of the multibillion industry.²

Opium prevalence has substantially fallen over the hundred years of the international drug control system's existence. Unfortunately, the statistics for cocaine are less positive. Whilst legal manufacture of cocaine fell by 98%, illicit production of the same rose rapidly. Cocaine use increased from less than 0.1 % to 0.24 % over the period and overall manufacture of cocaine increased dramatically from 15 ton in 1903 to 994 tons in 2007, (United Nations Office on Drugs and Crime, 2008;b). Whereas, heroin remains the most dangerous drug in terms of negative health impact, cocaine emerged as the number one problematic drug when it comes to drug-related violence (United Nations Office on Drugs and Crime, 2011, pg. 85).

2.2. Institutional background

The international drug control system is built on three prominent conventions. Firstly, the 1961 Single convention authorizes the International Narcotics Control Board (INCB) to exert control over the drug production. The Convention says that INCB "*...shall endeavour to limit the cultivation, production, manufacture and use of drugs to an adequate amount required for medical and scientific purposes...*" and: "*to prevent illicit cultivation, production and manufacture of, and illicit trafficking in and use of, drugs*" (United Nations, 1961, pg. 5). The convention requires all parties to adopt measures that shall make any action; including cultivation, production, manufacture, etc., that is contradictory to the provisions of the convention, a punishable offence. The Single Convention puts a focus on supply control. Article 26 of the convention already states that parties: "*shall destroy the coca bushes if illegally cultivated*", (United Nations, 1961, pg. 14).

² Estimated total income derived from cocaine industry in 2009 is 85 billion USD (United Nations Office on Drugs and Crime, 2011).

Secondly, the 1971 Convention on Psychotropic Substances expands the international system of drug control over manufactured drugs, such as amphetamine-type stimulants, and gives more room to demand control strategies. Concerning plant-based drugs, such as cocaine and heroine, this convention does not bring much change (United Nations, 1971).

Thirdly, the 1988 Convention "*recognized the links between illicit traffic and other related organized criminal activity...* ". And that "*illicit traffic generates large financial profits and wealth enabling transnational criminal organizations to penetrate, contaminate and corrupt the structures of government, legitimate commercial and financial business, and society at all its levels*" (United Nations, 1981). Hence the 1988 Convention clearly recognized the high levels of income violent groups derive from illicit drug production

The Institution understands illicit traffic in a very broad sense, including the "*production, manufacture, extraction, preparation, offering...*", as well as "*cultivation, possession or purchase for the purpose of all previous...*"³ (United Nations, 1981).

To respond to the drug problem, article 14 of the Convention requires that: "*each party shall take appropriate measures to prevent illicit cultivation of and to eradicate plants containing narcotic or psychotropic substances, such as opium poppy, coca bush and cannabis plants cultivated illicitly in its territory...*" (United Nations, 1981). Therefore the most recent of the three significant conventions clearly requires Colombia, and other supplying states to eradicate coca fields and reduce the drug supply.

2.3. The story of cocaine

The coca-leaf has been cultivated and consumed by the indigenous Inca population at least since 3000 B.C. After the Spanish conquistadores arrived in South America,

³ Article 3 of the 1988 Convention enumerates a number of actions that shall be listed as criminal offences. For example production, sale, purchase, possessing, offering, but also cultivation for the purpose of production, handling of equipment as well as financing, and managing such action, transfer of property derived from such offences or inciting others to commit any of these actions.

coca-leaf cultivation was almost brought to an end due to the pressure from the Catholic Church, who associated coca use with the devil. However, coca consumption can enhance workers performance, reduce caloric requirements, prevent labour actions as well as forestall altitude sickness. The Spanish conquistadores realized they could make use of these "*benefits*" of coca consumption and because negative health-related and other risks were not taken into account they started to promote coca consumption among the indigenous population in the Andes (United Nations Office on Drugs and Crime, 2008;b).

Perishability of coca-leaves didn't allow for large exports until a cocaine alkaloid, enabling for cocaine manufacture was discovered. The popularity of cocaine was rising rapidly at the end of 19 century for many reasons. Positive effects on workers productivity, popularization by recognized personalities, such as Sigmund Freud, and growing use in medicine, dramatically increased cocaine demand. Coca cultivation was introduced in other areas outside South America, e.g. Java, Sri Lanka and Taiwan.

However, the negative consequences of cocaine consumption soon became obvious and cocaine, formerly used as a cure for opium, morphine and alcohol addictions, joined the same group of harmful drugs (United Nations Office on Drugs and Crime, 2008;b). Nevertheless, the illicit cocaine market continued growing at high pace. Colombia had remained, for most of the time, rather a secondary supplier. However, due to the crackdowns in Peru and Bolivia, the coca industry moved to Colombia. In 1997, Colombia became the biggest supplier of cocaine and the coca cultivation grew rapidly. By 2000, Colombia grew 74 % of the world's total coca leaves. Over the past decade, Colombia survived a period of an intense coca reduction effort and as some recent reports suggested, Colombia may again be the smallest of the big three cocaine suppliers (Economist, 2013).

While a balanced approach between supply and demand reduction efforts is agreed to be most efficient, the current stabilization of the cocaine market is believed to be mostly supply-driven (United Nations Office on Drugs and Crime, 2012, pg. 90).

The Colombian government succeeded in dismantling the two main Colombian drug cartels - Medellin and Cali, who had a monopoly over the global cocaine supply in the mid 90s. The supply went under the control of a large number of small cartelitos, usually selling the production either to Mexican groups, or directly to European customers (United Nations Office on Drugs and Crime, 2012, pg. 84). An analysis of the cocaine source to the USA, conducted by United Nations Office on Drugs and Crime (2007, pg.176 - 182), reveals that the transportation remains organized, centralized and in the hands of Mexican syndicates. Moving closer to the raw material, the decentralization increases and the cocaine supply becomes under the full control of Colombian groups. Coca production is now under the control of a number of specialized laboratories directly linked to organized crime.

Unlike production of the drug, coca cultivation is a highly decentralized family-like activity, involving up to 68 000 households in Colombia. Different prices are paid for the coca base in different regions, indicating that paramilitary groups and cartels use mechanisms to encourage and control coca cultivation in Colombia. Hence farmers are not making decisions based merely on market situation (United Nations Office on Drugs and Crime, 2007, pg.176 - 182).

The supply and demand interactions on the cocaine market

The illicit drug market operates under the rules of supply and demand. This interaction is however influenced by addiction and interdiction. Earlier understanding of the cocaine market interaction was that the demand for cocaine is price inelastic. The finding that drug users seemed not to react to changes in drug prices was interpreted as evidence of price inelasticity, i.e. consumers will demand the drug regardless of the price because they are addicted to it and thus in need of the substance.

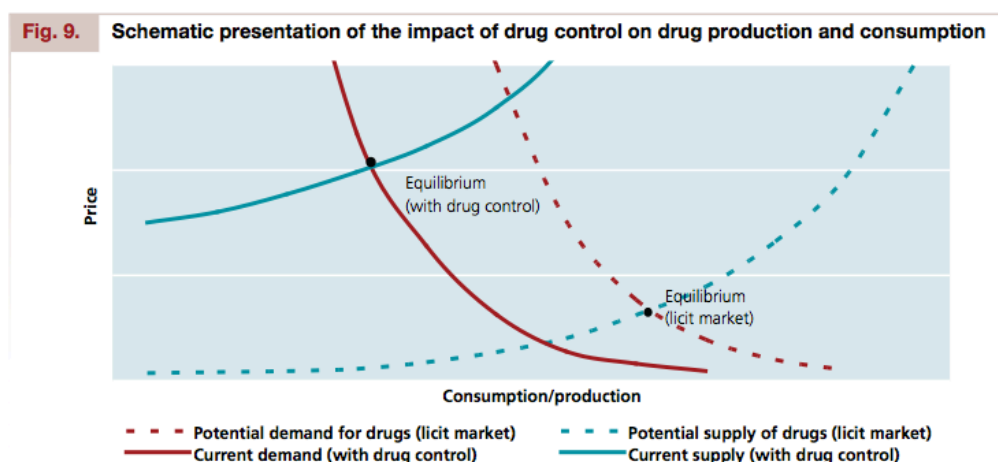
However, recent findings support arguments that demand for illicit drugs is actually price elastic, i.e. the demand declines with higher prices. The demand elasticity for the particular drug varies for the recreational users and dependent users, however the demand eventually declines for both groups (United Nations Office on Drugs and Crime, 2012, pg. 68). It does not necessarily mean that the new findings are denying earlier conviction about drug price inelasticity. The drug market could have changed

and the demand could begin to react to price changes. Higher numbers of recreational drug users, or better availability of alternative drugs could explain why the demand is now price elastic.

Regarding the supply side aspects, subjects decide how much they will produce and supply based on their costs. Unlike the licit production, the costs of raw material and manufacturing play rather a small role in the case of cocaine. More important is transportation, or distribution costs, and especially the risk-related costs. As the cocaine market is illegal (except for a small fraction for medical and scientific purposes), suppliers face the risk of being caught and punished. Such risk adds up to the financial costs.

The United Nations Office on Drugs and Crime (2012, pg. 68) describes that the presence of a drug control system increases the risk of illegal production. This risk adds to the costs and therefore it will discourage some of the producers from cocaine supply chain. Illustrating this on a graph, the supply curve will move to the left with increasing supply reduction efforts. Similarly, demand control causes the leftward shift of the demand curve. If both curves move to the left, it is clear there must be a new equilibrium on the market. The new equilibrium will be at lower consumption levels and higher prices. See **Figure 1** for illustration.

Figure 1: Impact of drug control on drug production and consumption.



Source: UNODC.

2.4. Supply reduction

Supply reduction aspires to cut off the raw material that can be used for the production of an illicit substance. This approach is hard to employ with most synthetic drugs whose production is dispersed in many laboratories all around the world. But cocaine is a plant-based drug, extracted from leaves of a unique plant, which is currently cultivated exclusively in a small area in the Andes - within Colombia, Peru and Bolivia. The USA continues to be the main promoter of the supply reduction approach to the cocaine problem. Crop eradication and provision of alternative development is the central tool for reducing the production of illicit drugs and one of the main counterdrug strategies for the US (Congressional Research Service, 2012, pg. 24).

Three methods are used to reduce coca supply; (i) eradication, (ii) alternative development and (iii) law enforcement. Firstly, the eradication of the illegal coca plantation can be done either by manual eradication or aerial spraying. The idea is to destroy the coca bush so less cocaine can be produced. Secondly, alternative development encourages the farmers to voluntarily abandon cultivation by offering them an alternative option - cultivation of a licit crop. The third method of supply reduction is interdiction, or law enforcement, usually targeting the production facilities such as cocaine labs, etc.

At the session of the United Nations General Assembly in 1998 participants made a commitment to eliminate or significantly reduce the illicit cultivation of coca bush and other plants by 2008 (United Nations, 1998). However, United Nations Office on Drugs and Crime (2009, pg. 64) reported only a slight decline from 190 800 ha in 1998 to 167 600 ha in 2008. A session gathered after 10 years expressed a concern about the continuing threat associated with drugs and rescheduled the previous target date for the commitment to significantly reduce or eliminate cultivation by 2019 (United Nations, 2009).

The session articulated 5 shortcomings of present-day illicit drug supply reduction efforts: (i) lack of cooperation, coordination and law enforcement, (ii) poor reaction to new trafficking trends, (iii) poor reaction to increased violence associated with illicit

drugs, (iv) lack of balanced approach, and (v) lack of anti-corruption measures, technical assistance and capacity-building (United Nations, 2009).

Regarding the lack of cooperation, the session called for strengthening of research, data-collection and assessment tools. There is still a knowledge gap and therefore the on-going research should "*monitor and assess the qualitative and quantitative impact of alternative development and drug crop eradication programs*" (United Nations, 2009).. Findings of this study could help to indicate some areas where the "*knowledge gap*" needs to be filled,

Sequence of supply reduction components

An Action Plan on International Cooperation on the Eradication of Illicit Drug Crops and on Alternative Development adopted as a resolution A/RES/2-20/4 by the General Assembly of the United Nations recognizes that: "*effective crop control strategies can encompass a variety of approaches, including alternative development, law enforcement and eradication*" (United Nations, 1998, pg. 1). Alternative development is defined as: "*a process to prevent and eliminate the illicit cultivation of plants containing narcotic drugs and psychotropic substances through specifically designed rural development measures...*"(United Nations, 1998, pg. 1). The action plan recognizes that in low-income structures, alternative development is more sustainable and appropriate than eradication.

The Action Plan, as adopted by the General Assembly, explicitly suggests a roadmap to successful supply reduction of coca. The first step is to implement alternative development programs. However, the existence of alternative development programs is not the only motivation for farmers to abandon the production voluntarily. Therefore, law enforcement instruments must become effective to pose a risk on the farmers intending to cultivate illicit crops. Eradication comes as a last resort solution.

Unlike the Action plan some actors, such as the US, or Colombian government, seems to view the process in a reversed order. Whilst the Action plan suggests that people will move toward licit crops, when the opportunities are available and risks visible, Plan Colombia provides these programs to support the transition of Colombian regions. Because eradication will make cultivation of narcotics less profitable,

alternative development programs will help the region with the transition to licit economic activity.

2.5. Supply reduction programmes in Colombia

The Colombian case shows characteristics of the "*war on drug*" strategy with a dominating "*zero tolerance approach*". Many anti-drug programs in Latin America have been developed in cooperation with the USA and in most cases put emphasis on supply reduction, such as crop eradication and interdiction. For Colombia a major strategy called Plan Colombia was created between 1998 and 1999. Among others, Plan Colombia aimed at reducing cultivation, as well as processing and distribution of illicit drugs. It encompassed variety of assistance for programs targeting eradication, alternative development, interdiction, and capacity building as well as support for civilian and military institutions.

Plan Colombia

Plan Colombia is a specific strategy of the Colombian government strongly supported by the USA to meet the challenges the country faced at the turn of the millennium. Amongst others, Plan Colombia focused on combating the narcotics industry. Proposed costs of the program totalled \$ 7.5billion for the first two years. The Colombian government raised over half of the amount and the US promised a package of \$ 1.6 billion; of which \$ 600 million should have been used to help train and equip counter-narcotics battalions, \$ 145 million on alternative development programs, \$ 340 million for interdiction and \$ 96 million to enhance Colombian National Police eradication abilities (State Department, 2000).

In 2008, the United States Government Accountability Office concluded that drug reduction goals (as agreed in Plan Colombia) were not met, but security had improved. Nevertheless, coca cultivation did rise by 15 %, and production increased by 4% (Government Accountability Office, 2008). However, later data from Office of National Drug Control Policy (ONDCP) (the same source as used for the report) shows that since 2006 the production was continuously falling and by 2011 it was down by more than 60%.

The US embassy in Bogota summarizes Plan Colombia as a success. The reason for such a conclusion is the fact that the country experienced a rapid decrease in homicides, kidnappings, as well as terrorist attacks and attacks on infrastructure between 2002 and 2008. In 2007, the Colombian government introduced a new strategy based on Plan Colombia, by increasingly focusing on social services provision, strengthening democracy and economic development (US embassy and Plan Colombia, n.d.).

President Uribe's administration strengthened Plan Colombia in 2003 with a "*democratic security*" strategy. Uribe's idea was that under this strategy, security forces would enter areas in order to stabilize them and ensure that civilian agencies can provide education, justice, health and other social services.

Recently, the USA has been gradually shifting the responsibilities for counterdrug programs, as well as security to Colombian authorities, but the orientation on supply reduction approach seems to remain unchanged (Congressional Research Service, 2011).

Reducing the coca supply in Colombia

Developments in coca supply reduction efforts since the creation of Plan Colombia can be described in three phases. Initially, the dominant strategy was aerial spraying, followed by the focus on manual eradication and finally alternative development programs were emphasized.

The sequence of these is logical. In the turn of the millennium, many areas under coca cultivation were out of governmental control, thus accessing them would be dangerous or even impossible. Low-flying planes can spray large areas at relatively low costs, labour intensity and risk. While aerial spraying became the centre of criticism for its impact on environment, public health, or socioeconomic situations, the use of this method has been declining since its peak in 2006. However, manual eradication continued to increase.

Spraying allowed access to previously inaccessible areas for newly trained battalions. More effective manual eradication could replace questionable aerial spraying.

However such methods require many workers, who would soon become targeted by drug traffickers. For example, violent groups installed a number of landmines to protect coca fields. Moreover, destroying the coca plant does not necessarily mean that the farmer will cease coca cultivation. The need for income and pressure from drug traffickers to renew coca fields often gives no other option but to return to illicit crop cultivation. **Figure 2** illustrates coca-related data for the period of 2001 - 2011.

Figure 2: Coca cultivation, production and eradication in Colombia.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cultivation (Hectares)	169,800	144,450	113,850	114,100	144,000	157,200	167,000	119,000	116,000	100,000	83,000
Production Potential (Metric Tons)	700	585	445	410	500	510	470	285	280	260	195
Eradication (Air)	84,251	122,695	127,112	131,824	134,474	164,119	148,435	129,876	101,573	97,836	103,302
Eradication (Manual)	1,745	2,762	4,220	6,232	37,540	42,110	64,979	95,731	60,954	43,957	34,592

Source: Office of National Drug Control Policy

The last phase is alternative development. These programs are long-standing in terms of impact as well as implementation. Providing farmers with incentives to grow licit crops would probably not be possible without previous steps during which the government gained a presence in the territories and thus could ensure the farmer's security, as well as decent income. However, even alternative development has its flaws and criticism. For instance, low availability of the programs, non-sufficient infrastructure for farmers to transport their licit production, or low effectiveness etc.

3. Theories, Research and Response

The third chapter of this paper will present theories and academic research, as well as the policy maker's response to academic and theoretical claims. This chapter is divided into three subsections. Firstly, the theory on drug violence link, as well as two theoretical models explaining the interactions between violence and supply reduction policies. The second subchapter will present academic research, including the impact of supply reduction efforts that has been conducted so far. The third section of this chapter will conclude the previous two.

3.1. Theories

The Link Between Drugs and Violence

Although it is not clear whether the presence of drugs creates violence or if a violent environment attracts the drug market, there is no doubt about the existence of the link between the two. Such establishment is already engraved in the 1988 Convention (United Nations, 1988). The link is observable in all producing, transit and consuming countries and drug trafficking often accounts for a large part of revenues for organized crime groups who use it to support their activities, including violence.

Ikelberg (2003) considers the drug - violence link as a self-fulfilling vicious circle. While illicit crops will most likely be cultivated where the government is weak and national forces have little control over the territory, the presence of drugs will finance and aggravate the conflict. Although a weak state is an important factor, Ikelberg also considers other factors that attract the drug economy; for instance poverty, social and economic problems, or lack of opportunities. Ikelberg (2003) supposes that the presence of a drug economy has 5 consequences, one of them being the increase in violence. Drug traffickers fund conflict in the region, use their resources to eliminate institutions, or individuals who stand in their way and engage in armed conflict as well as rivalry wars. Clashes also occur when farmers fail to repay credit and other dispute settling cases. The drug economy also deteriorates the business climate and promotes illegal activity.

A study carried out by Perez, Vergara and Percipiano (2002, as cited by Ibanez, 2007) calculated that costs of illicit drug production are equivalent to about 1 % of Colombian GDP. Ibanez also adds that income from drugs could lead to a larger proportion of people carrying weapons, more robberies and higher alcohol consumption.

Singer (2008) pledges to include drugs among factors posing a threat to development. He provides a summary of five impacts of drugs on development. Violence and corruption, as well as an impact on productivity, threat to youth and health problems make up this group. Singer (2008) summarizes that much of the drug-related violence

is most likely to be the result of the fight for the drug market among various groups, a response to increased pressure from the government, or reaction on major disruption on particular drug market.

Income from illicit drug trade gives traffickers resources to: "*evade government detection; undermine and co-opt legitimate social, political, and economic systems through corruption, extortion, or more violent forms of influence; penetrate legitimate economic structures through money laundering; and in some instances, challenge the authority of national government*", Congressional Research Service (2012, pg. 6).

Similarly, the United Nations Office on Drugs and Crime (2010) views drug trafficking to be risky in two ways. First, the illegal armed groups may tax or manage illicit drug production, and second, these groups may have enough power to undertake violent actions.

According to the Congressional Research Service (2011, pg 6), research has shown that drug related violence became the primary source for insecurity, especially in drug transit and production countries. Drug trafficking groups use violence to protect their routes, or in some cases to undermine police and criminal justice institutions. Nevertheless, whilst Latin America remains a region with the highest crime rates in the world (on average as little as 5 % of murders committed in Latin America will result in criminal conviction), Colombia conversely made a progress in reducing crime and violence lately.

The justification for eradication efforts in Colombia seems to be clear in theory. It is the finding that paramilitary and insurgency groups, such as FARC, AUC, or ELN, derive large profits from illicit trade with cocaine. Cutting these groups from such income should reduce their capacity to undermine civil institutions and to involve in violent activities. For instance, in the early years of Plan Colombia, Carlos Castaño, a commander of AUC, revealed in an interview that landowners were no longer able to pay their "*security payment*"⁴ to the AUC and drug money accounted for up to 70 % of organisation's revenues (Economist ,2000).

⁴ initially the main source of income for AUC

The value of the global cocaine market has shrunk and cocaine prices fell. Violent groups in Colombia had to face a decrease in their drug-related incomes. The overall income derived from cocaine retail sales fell from an estimated \$ 165 billion in mid 1990s to about a half, \$ 85 billion in 2009 (United Nations Office on Drugs and Crime, 2011, pg. 124-125). Above that, United Nations Office on Drugs and Crime (2012, pg. 85) presents Colombia as the case where supply reduction efforts did result in loss of income for paramilitary groups, specifically FARC. For this reason there may be a decrease in violence in Colombia.

Many analysts agree that Plan Colombia helped to reduce violence in the country, but also had other consequences, for instance, displacement, environmental damage, and coca cultivation dispersion (Congressional Research Service, 2011). Nevertheless, United Nations Office on Drugs and Crime (2012, pg. 95) suggests continuation of recent eradication efforts of coca leaf production has a chance to be eliminated as previously was the case of Thailand. Though declining, yet still above the average levels of violence in Colombia, adds additional incentive to combat the drug industry.

Andersson et al. (2006) conversely contradicts the drug - violence link. They suggest that violent groups may not generate as large of a profit from drugs as it has been thought. In their brief calculation, using UNODC's estimates on wholesale cocaine price, they assume, that each violent group in Colombia can generate only about USD 100 million a year from the coca business.

Mathematical models incorporating supply reduction policies and violence

Burrus (1999) and Caulkins & Reuter (2006) created two mathematical models explaining the effects of supply reduction on violence. While Burrus (1999) argues that supply reduction efforts will reduce the violence, Caulkins & Reuter (2006) advocate for the opposite.

Burrus (1999) built a theoretical model that could explain the relationship between supply reduction and violence. His model sees drug suppliers as geographic monopolists who make decisions to commit violence depending on profits they expect to gain from the territory under their control. Drug suppliers commit violence in order

to secure their territory, however, they also have to take into account the costs of committing a violent act. If the violence is at its optimal level, the marginal benefit of committing a violent act is equal to the expected costs of such a violent act.

Therefore, Burrus theorized, that if supply reduction had increased, suppliers would have lowered the quantity of drugs they supply, while increasing the price. Despite the higher prices, the overall expected profit for the particular supplier derived from his territory will decrease. With decreased profits, the marginal benefit of committing a violent act is also decreasing hence, the supplier will decide to commit less violent actions than before the increase in supply reduction efforts. According to Burrus, the theoretical model is roughly consistent with data from the period of 1989 - 1997.

On the other hand, Caulkins & Reuter (2006) contested the standard model. Their model attempts to explain the empirical findings that cocaine price has not increased, as assumed by the standard model, but rather decreased. They consider several supply reduction policies, but only one - removing an individual from the drug market may have a positive effect on overall levels of violence. The removed individual will be replaced, however, the benefits occur in a case when abnormally violent individual has been removed and replaced by a less violent one.

Other interventions of supply side policies considered in the model such as increasing enforcement at known sites, increasing penalties for dealing drugs, or arresting drug users may have a significant adverse effect on violence.

Nevertheless, the model of Caulkins & Reuter (2006) only considers supply reduction policies on the market of consumption (i.e. supply reduction in cocaine) and unlike Burrus (1999) does not mention eradication or other supply reduction policies in the country of drug's origin (i.e. supply reduction in coca). Moreover, though these theoretical models could possibly be applied in the case of Colombia, they focus rather on the violence levels on the market of consumption and do not consider the specifics of the cocaine market (e.g. concentration of production, and other factors).

Operationalization of violence

Poveda (2012) investigates the determinants of violence in 7 cities of Colombia. He conceptualizes the violence as a cost benefit analysis. In line with Becker's paradigm, formed in late 60s, he assumes that individuals allocate their time between legal and illegal activity while considering return of such activity to be the benefit and risk and rigorousness of punishment to be the cost of violence.

To measure violence, Poveda (2012) uses homicide rates. Moreover, he concludes that there is a relationship between drug seizures and homicide rates and interprets his finding that higher level of drug seizures will result in lower motivation to commit a violent act. His findings could be theoretically applied to supply reduction in general. With increasing supply reduction, motivation to commit violence should decrease.

Preliminary conclusion

To conclude, a comprehensive bulletproof theory that would effectively describe the relationship between the two variables - coca supply reduction and violence in Colombia, has not been developed. This chapter will now present academic research and will conclude with a set of theoretical as well as empirical claims that will serve as a theoretical framework for this study.

3.2. Earlier research

General research on supply reduction

A majority of research on supply reduction programs aimed at cocaine or drug related issues focuses on the effects of particular programs on drug availability, use, price or similar characteristics observable in the country of consumption. Only a few studies look on the manifestations of supply reduction programs in the source country. Papers examining effects of supply reduction efforts in the country of production focus mainly on the link to environment, health, and socio-economic characteristics.

Aerial spraying has been criticised by many studies, especially for its negative impact on environment, health, water contamination, or impact on licit cultivation. For example Peterson (2002), Ferrer (2005), or Shields (2005). Spraying has also been criticised for its ineffectiveness as farmers always found ways to avoid damages

caused by spraying. Farmers increasingly moved their production deeper into the jungle, started to cultivate coca on smaller fields in order to be less attractive to fumigating planes, or mix licit with illicit crops. If spraying was followed by rainfall applied substance was washed away and the harvest was saved. Likewise, farmers realised that washing the crops after spraying would save their harvest. Refer, for example, to Wilson (2001).

Eradication, including aerial spraying and manual eradication has also been criticized for negative socio-economical impacts. Coca cultivation is often the only profitable activity for farmers in remote, rural areas of Colombia. Farmers simply have no other option than to reinstate coca fields, as there is no licit alternative that would generate sufficient income. Programs of alternative developments became increasingly highlighted.

On the contrary, US government refuses the criticism, arguing that only 15 % of glyphosate, criticized for causing environmental and health damages, is used for eradication. Colombian farmers use the remaining 85 % for agricultural purposes in the licit production. Moreover, the US government argues, that chemicals used to produce cocaine are those that should be blamed for contaminating water sources. Concerning claims that aerial eradication often miss the target and destroy licit production, Washington admits that out of 7 800 claims, about 100 of them was verified and affected farmers were reimbursed. No claim of harm to health have been ever verified (Embassy of the United States, n.d., or Congressional Research Service, 2005).

Results of supply reduction programs in Colombia

Supply reduction efforts keep to be presented as a tool to cut violent groups from their illicit drug income. Long time supporter of eradication is the US. The White House (2005, pg. 41-43) appraises the recent decline in cocaine production and claims, that eradication is the factor that significantly reduced the amount of money flowing to narcoterrorist groups. Recent National Drug Control Strategy remains stubborn regarding eradication, however more emphasis seems to be put on alternative development programs. The White House (2012, pg. 35) states that alternative development in combination with government presence and eradication efforts

continues to be the prominent tools to reduce cultivation. The case of Peru is used as an example to demonstrate the success of this approach.

Buckley (2004) also views the Plan Colombia as a success because it achieved bringing down terrorist attacks by 53 %, kidnappings by 34 % and homicides by 45 %. Buckley agrees with the US approach to use eradication first. According to him, the first step is to cut the violent groups from the drug money in order to decrease violence. As a conclusion, Buckley gives several recommendations. He points out that while supply side measures are necessary, they are not sufficient and must be complemented with demand reduction. Also he recommends continuation of the policy as the insurgent groups may still possess some resources that allow them to continue fighting.

Elhawary (2010) also agrees that the security in Colombia has improved thanks to the Plan Colombia and more recent "*democratic security*" policy. However, he is questioning the universality of the security gained and argues that while many urban and economic centres have been stabilized, the situation on rural areas remained unchanged.

Similarly, some studies criticize that the relationship between coca cultivation and violence does not hold up when looking at regional rather than national data. One such study has been published by Holmes et al. (2006) who analysed the link between crime and violence in four departments⁵ with high coca cultivation and high violence levels. They conclude that there is a significant and positive link between coca eradication and leftist guerrilla violence. Holmes et al. found a negative relationship between export and violence hence they suggest that: "*meaningful opportunities for the inclusive economic development should be promoted...*". The time period, for their analysis, spans from 1991 to 2001.

Reyes (2012) looks at even smaller administration units. He quantifies the relationship between eradication and coca cultivation in 257 municipalities (out of 1119). His findings indicated that a one per cent increase in eradication efforts results

⁵ out of total 32, respectively 33 including the capital

in approximately a 1 % increase in cultivation. The analysis takes into account years 2001 - 2006. Reyes (2012) points out that alternative methods of coca reduction have been underfunded and suggests that: "*A carefully planned relocation of government spending from eradication to alternative development may be a first step toward finding effective ways to reduce coca production in Colombia.*" However, the analysis on a municipal level uses data on eradicated area, thus not including other supply reduction methods.

The opposite result was found by a study on La Macarena municipality, an assessment of the Plan de Consolidación integral de la Macarena, published by DeShazo et al. (2009). Currently, there is a strong military presence in the region. 5 out of 6 municipal urban centres are now secure and with declining coca cultivation. Authorities are confident that FARC's income from drugs has been disrupted in this region. However the situation few years ago was completely different. Historically, La Macarena region has been the centre for FARC's operations as well as major coca cultivating region. The process that resulted in current stabilization of the region started with aerial spraying. Due to the criticism of aerial spraying, since 2006 only manual eradication has been used. As a conclusion, authors recommended, amongst other measures, to closely focus on alternative development and support eradication with short-term food aid and cash subsidies. Although much remains to be done, the case of La Macarena region can serve as an example for a successful transformation of other regions in Colombia (DeShazo, 2009).

USAID (2009) further highlights that state presence is crucial for counter narcotics efforts. The security provided by the presence of the state undermines the narcotics activities of armed groups. Moreover, security serves as a necessary precondition for successful anti narcotics policies, especially alternative development. For instance, in times of insecurity, attacks prevent land traveling therefore, farmers could not deliver their licit harvest.

Similarly, Andersson et al. (2006) argues that aerial spraying takes place because the state is not present in many parts of the country. In such a case, it is the only method available. If state presence is restored the government can take on more effective methods, such as manual eradication, or interdiction of cocaine labs. Similarly, the

US government, though not contesting the benefits of alternative development programs, argues that aerial spraying should be preceded by eradication.

Outside Colombia there are not many examples of successful supply reduction policies. Roberts et al. (2004) claim that concerning plant-based drugs, one such example is reduction in Myanmar and Laos. However, positive results were associated with large costs. The authors argue that according to the basic rules of economics, results of policies oriented in supply will only be a short term solution unless accompanied with effective demand side policies.

Shift in understanding of drug related violence

An earlier understanding that violence is an effect of drug use has been increasingly contested. None of the authors argue about the positive correlation between drug use and violence, but most explain it through social marginalization. Though a significant number of crime is committed in order to obtain money for drugs, these are often petty crimes. Such crime is mostly "*systemic*" and these individuals would most likely commit crimes irregardless of using drugs (for example Stevens, et al., 2005; or United Nations, 2003). More serious violence is associated with groups that aspire to gain or maintain a share of the illicit drug market. For example Brownstein (2000) conceptualized drug-related violence as a form of dispute settling. While disputes in legal economic activity can be settled at court, disputes in the illicit drug market are resolved through violence.

Unfortunately, only a few studies investigate the effect of supply reduction on violence. Werb, et al. (2011) conducted a English language literature review to examine the impact of law enforcement on drug violence. By searching databases for relevant terms, including "*violence*", "*drug-related violence*" etc., the authors indicated 314 potentially eligible studies. Of these, 299 were excluded due to not presenting new data or deemed as non-relevant. The analysis revealed that out of 15 eligible studies, 93 % reported an opposite effect of law enforcement on violence, i.e. increase in violence with an increase in law enforcement efforts. One study reported no significant relationship.

Although, the review by Werb, et al. (2011) is extensive, it used studies dealing mostly with analysis conducted in the 90s. Moreover, most studies examined the law enforcement - violence link in the country of consumption, predominantly in the US and Australia.

Another study by Cornell (2005) examines the effect of drug presence on conflict. Following the literature on natural resource curse, the author argues for the inclusion of drugs into the same category. His study found that although the presence of drugs does not appear to be linked with the emergence of a conflict, drug production is boosted during the armed conflict. Such increase of drug production allows insurgents to support their activities and finance the war. Hence the presence of drugs is likely to prolong the duration of the conflict.

Data Concerns

A small number of researchers challenged the official estimates of coca production. For example, Leoncini et al. (2012) advocate for a different methodology to calculate coca production. Investigating developments of coca price, supply and demand, authors claim that numbers in official statistics on coca cultivation are likely to be lower than reality. There are three reasons they claim to be the causes for such underestimation. First, the official measurements of coca cultivation do not cover the entire area where coca may be cultivated. Second, corrections and assumptions pose a high level of uncertainty and third, mixed fields (legal and illegal crops on one field) may not be detected by current measurements. The threat their finding has on this study will be discussed later.

3.3. Theoretical summary

Current understanding of the drug related violence has shifted away from being considered as the consequence of drug abuse. It is now agreed that most of the violence is associated with the fight over the drug market. Drug-related violence can be understood as a form of "*dispute settling*", or effort to gain or preserve presence on the market. Drugs remain to be a significant income for the violent groups in Colombia.

Many politicians agree that to break the drug - violence link, the coca supply must be curbed. Supply reduction will however be only short termed, and supply would bounce back immediately after the withdrawal of the reductionist policies to satisfy the demand, unless it is accompanied with a decrease in demand. Globally, cocaine demand remains constant, however the demand in the USA has significantly decreased. Numerous reports suggested that Colombia produces nearly all of the US supply, while Peru and Bolivia are suppliers for other markets. With a decrease in the US demand and higher use of alternative development programs, cocaine supply reduction in Colombia can now be, as many policymakers believe, successful and sustainable.

However, reduction in the cocaine market supply could have effects on violence levels in cocaine production regions. There are two camps, each arguing for the opposite effect. One camp supports the claim that supply reduction does decrease violence. Supply reduction, including alternative development as well as eradication promotes licit economic activity, as well as it increases the relative costs (especially the risk) for coca suppliers. Therefore with less drugs, violent groups controlling the production in Colombia should have less capacity or incentives to act violently, hence the violence levels should decline. To promote the development of Colombian regions, government needs to gain the presence over the region and ensure the provision of public goods, especially security, education and infrastructure, as well as various alternative development programs that provide farmers with an alternative choice to coca cultivation.

Others, however, disagree and believe that there is an adverse link between supply reduction and violence, i.e. with more supply reduction, there will be more violence.

4. Methodology

Based on previously described theory and empirical research, the fourth chapter will present the concept which will be used in this study. This chapter will also discuss several assumptions and the data used in the analysis. To remind, the research question is asking: "*Can the reduction in coca cultivation be interpreted as successful in terms of stabilizing the security situation in Colombia?*"

4.1. Concept and assumptions

This study aims to research the link between illicit drugs and violence. The link is well established and has not been significantly contested. More specifically, this study aims to investigate the effects of drug reduction on the local levels of violence, which is a less known area of study.

The independent variable in this study is area under coca cultivation. It is influenced by eradication, interdiction, as well as alternative developments. As described earlier, these efforts may have an impact on violence levels, which is the dependent variable in this study.

As it is known that armed groups derive significant profits from drug trafficking and use them to commit violence in order to secure their activities and as such, lowering coca supply will decrease their profits. This can have an effect on violence because armed groups will either loose their capacity to get involved in violent activities or conversely, increase the pressure to win the lucrative market back.

Hypothesis

In compliance with the previous sections, there may be an observable manifestation of the drug - violence relationship. Lets suppose that the argument of policy makers is correct and the coca reduction will cut violent groups from their income causing them to loose the capacity to get involved in violent acts. The following hypothesizes assumes this argumentation.

Considering the marked decline in Colombian coca cultivation, which fell from 163,000 hectares in 2000 to 64,000 hectares in 2011 (United Nations Office on Drugs and Crime, 2012;b), the hypothesis expects a decline in violence levels:

H1: Reduction in coca supply will translate into decline of homicide rates.

H2: Reduction in coca supply will translate into decline of kidnapping rates.

Assumptions

Naturally, this study builds on several assumptions that may pose some limitation to the findings.

Assumption I: Equal levels of productivity

In recent years, Colombian cocaine labs have developed more efficient ways for extracting cocaine from coca leaves. If the productivity would vary across Colombia, decrease in coca cultivation in one area could be offset by an increase in productivity, hence the same amount of cocaine could be produced and generate similar income with different amounts of input.

There is no precise data statistics for local level production or productivity. The reason is that measuring production is very complicated. For example, a method estimating local level productivity from interdiction data may be significantly biased as local authorities tend to overestimate the productivity in order to escalate the importance of the particular interdiction. No impartial institution is authenticating interdiction data. For these reasons, the study uses coca cultivation data and assumes that the productivity does not significantly vary across Colombian regions.

Assumption II: Homogeneity of the regions

The second assumption is linked to the previous one. Likewise, it assumed that productivity is the same across Colombia. This study also assumes that other factors do not vary significantly. These factors are intervening variables that could influence variables under investigation, such as amount of coca leaf harvested from one hectare of cultivation, as well as amount of cocaine extracted from one coca leaf, transportation costs, revenues from the wholesale cocaine sales, etc. Also, at this

stage, the study does not assume a significant difference in general policy and conditions among various regions in concern.

Assumption III: Reliability of data

As the study relies on second-hand datasets, it is assumed that these are correct. Despite the strong efforts to measure cocaine supply production, the fact that the cocaine market is clandestine poses a major obstacle to the measurements.

For example Leoncini et al. (2012) argued that data concerning coca production may be underestimated. They use a different methodology for production estimation suggesting that the cocaine supply is underestimated. Section 4.2. Data and Measurement explains why their finding does not pose a significant threat to this study. Nevertheless, United Nations Office on Drugs and Crime (2009) is very confident about the precision of its coca cultivation estimation.

Assumption IV: Causality

The problem of "*what causes what*" is a central point to most of the research. This study assumes that the link begins with supply reduction. If reduction efforts are increased, it lowers profits for violent groups who consequently have to react to the lowering profits. It either gives them less capacity to commit violent crimes, or the groups with less income become desperate and increase their involvement in violent activities to "*win back*" the market or strengthen their existing positions. The point of this assumption is the direction of the link, not the positive or negative relationship. The reason is that the link could run the opposite way. With more violence from the armed groups, politicians would have higher incentives to crack down on coca cultivation.

Assumption V: GDP/capita as a proxy for dependence on coca cultivation

As has been described, coca cultivation is often the only economic activity that generates a decent income for many Colombians. It would be useful to be able to measure the "*dependence on coca*". Unfortunately, such data does not exist. While the unemployment rate could serve as a good proxy, there is a lack of data for many of the regions. Therefore GDP per capita can be used as a proxy for dependence.

The justification for using GDP per capita is that a higher value indicates that there may be more economic activities available for the coca producers. Also higher GDP increases the opportunity costs for coca producers. The reason is that labour can be allocated either in licit or illicit activity. An individual who decides to involve in illicit cocaine production has to sacrifice a potential income from his legal employment. In regions with low GDP per capita, this sacrifice is very small. However, if the GDP per capita is very high and could generate decent or even higher profits, less people would be willing to undergo the risks associated with coca industry.

4.2. Data and measurement

To measure the variables, there is a need for complex data that was taken from secondary sources. Therefore, it is necessary to discuss the database used in the analysis. The Colombian administration divides the country into 32 departments plus the capital city of Bogota, which is often mentioned as a 33rd department. Departments consist of smaller administrative units called municipalities and these are subdivided into even smaller corregimientos. This study uses data on the departmental level. Local level data on coca cultivation and homicide rates for the years 2004 - 2011 will be used.

Coca cultivation

Measuring the area under coca cultivation requires extensive resources and experience. Most extensive data on coca cultivation are provided by two main agencies - United Nations Office on Drugs and Crime (UNODC) and The White House Office of National Drug Control Policy. This study will make use of the data provided by UNODC. The reason for using UNODC data is that these seem to be more robust. Also, the US government did not cover the entire area under coca cultivation prior to 2005 hence previous data may be underestimated. UNODC achieved full coverage of their measurement in 2001.

Since 2002, UNODC publishes a Coca Cultivation survey for each country affected by cultivation of the illicit crop. For Colombia, the office measures the area under cultivation using satellite images collected between September and March of the following year. For the 2011 census, 87 images covering the entire territory except

that of the San Andres and Providence Islands were analyzed. The census uses repeatedly taken images from more satellites to avoid failures to the measurement caused by clouds and other disturbing elements. The images are geo-referenced, i.e. the image with least cloudiness is assigned to the map and visually analysed. To validate the data gained from satellite images, verifying overflights are being used.

After the analysis and validation, UNODC makes a series of corrections to the data obtained from the method described previously. An area reported to the UNODC as manually eradicated after the date when images were taken is subtracted from the total area under cultivation. Aerial spraying is also subtracted, but this method has a 2 % crop survival rate. To adjust for new fields that were planted after the images were taken, monthly increase/decrease rate is considered. Despite all the efforts to avoid clouds and shades, 15 % of the area, mostly in departments of Nariño, Norte de Santander, Choco and Cordoba had to be corrected due to lack of data. In these cases there are no usable images collected throughout the year, the cultivated area under clouds or gaps is estimated from past year census while taking into consideration the trend for the region. An area of coca cultivation, smaller than 0.25 hectares, may not be detected therefore, UNODC also estimates and adjusts the data for small fields (United Nations Office on Drugs and Crime, 2012;b, pg. 89-100).

Although using eradication data would seem to make more sense for the analysis, it would actually make it more complicated for two reasons. First, eradication often exceeds the total area under coca cultivation because many areas are being eradicated several times a year. Similarly, fumigating planes may miss their target hence the area fumigated does not necessarily correspond to the area where the coca supply has been decreased. Moreover, eradication data does not consider voluntary abandonments of coca field under alternative development programs. As the study aims to evaluate the impact of supply reduction in general, not specifically eradication, these forms of supply reduction need to be taken into account.

There have been attempts to challenge the official statistics on cocaine cultivation, for instance, Leoncini et al. (2012). Nevertheless, the authors themselves mention that the puzzle may also be explained by increased productivity in cocaine manufacturing, an alternative opinion argued for by the UNODC. Moreover, authors contested the

overall methodology used for coca cultivation measurements, so if the statistics are indeed underestimated, the total area would be higher proportionally in all the regions.

Violence

To measure violence in Colombia, homicide rates and data on kidnappings will be used in this study. Each year Instituto Nacional de Medicina Legal y Ciencias Forenses (INMLC) collects data on autopsies with murder being the probable manner of death. Homicide is understood as a criminal act of murdering a human. In order to compare homicide data across region, homicide rates, i.e. number of homicide cases per 100 000 inhabitants are being used. Homicide rate is being calculated by the INMLC itself.

Colombia experienced sharp decline in homicides rates, which fell to almost a half between 2001 and 2011. Most of the years, Colombia reported a statistically significant decrease in homicide rates, however especially in its earliest reports, INMLC pointed out the different murder distribution among Colombian regions. In 2001, INMLC enumerated Guaviare, Putumayo, Antiquia, Arauca, Valle and Risaralda as departments with highest homicide rates. Of these, Putumayo, Guaviare and Antiquia are among regions with the highest coca cultivation. In 2011, homicide rate in these regions remained above the average. Only Guaviare reported a rate of 38,15 which can be consider relatively close to the average of 35, 95, INMLCF (2011).

Statistics on kidnaping cases are collected continuously by two institutions - Fondelibertad and País Libre, as well as many NGOs and other organisations. Fondelibertad is an office of the Ministry of Defence responsible for creating policies against kidnappings. País Libre Fundación is a NGO founded in the 90s by Francisco Santos, current Colombian president. The data on kidnappings for the years 2004 - 2011 used in this study is derived from the Ministry of Foreign Defence of Colombia. Total number of kidnapping cases is converted into kidnapping rates using the population data taken from DANE, The National Administrative Department of Statistics.

5. Analysis

The fifth chapter is divided into two subchapters. First part of this chapter will present the method, which will be used in the analysis and the second part will present and discuss the results of the analysis.

5.1. Method

To approach the problem, I will use the SPSS program to analyse the relationship between coca cultivation, homicide rates and kidnapping rates. This study uses a dataset for coca cultivation including 23 departments for which significant coca cultivation is reported⁶.

The analysis will be made in two stages. First, it will be conducted separately for the 6 regions with the highest reduction of coca cultivation area reported, namely, Meta, Guaviare, Caquetá, Bolivar and Vichada (in decreasing order). This group will be referred to as "*top 6*". The reason for this step is that the aim of this study is to research the impact of supply reduction. In regions with increasing cultivation (for instance Cauca, or Putumayo) there would be negative values for reduction and it may have a different impact on violence, not necessarily opposite to the case when coca cultivation is being reduced. In the second step, the study will analyze the entire population of all 23 regions and compare both results.

The independent variable used in the analysis is "*area under coca cultivation*", or "*are*". There are also two dependent variables, "*homicide rates*", or "*hom*" and "*kidnapping rates*", or "*kid*". To differ between the "*top 6*" and the entire population, an index with the number of regions of concern will follow the variable. GDP per capita (in 1000 pesos) will be added as a predictor in the last part of the analysis.

The dataset used in this paper has a form of panel data (time series cross-sectional) i.e. dataset includes observations of N individuals over t periods of times. To be more

⁶ The dataset does not include the following departments: Atlántico, Casanare, Cesar, Huila, Quindío, Risaralda, San Andrés y Providencia, Sucre, Tolima and the capital city Bogotá.

concrete there are 8 observations for each year between 2003 and 2011 across 23 Colombian departments.

In the analysis a general linear model will be build. The panel data regression model is represented by **equation (1)**, where y_{it} is the dependent variable at time t for an individual i , α_i is the unobserved time-invariant individual effect, x is the independent variable, and β is the coefficient for the variable area under coca cultivation, u_{it} is the fixed or random effects and errors. More specifically, u_{it} consist of individual specific, time invariant effect as well as group effect and errors. In **equation (2)**, coefficient δ represents the coefficient for the variable GDP per capita.

$$y_{it} = \alpha_i + \beta x_{it} + u_{it} \quad (1)$$

$$y_{it} = \alpha_i + \beta x_{1it} + \delta x_{2it} + u_{it} \quad (2)$$

Several problems can be encountered with analysing panel data. The main problem is correlation of errors. An OLS regression could be biased it assumes that individual errors are not correlated. However, the panel dataset design can include spatial, contemporaneous or autocorrelation of errors. Spatial correlation of errors can occur if errors for one region are correlated across time, e.g. one region always reports higher values. Contemporaneous correlation of errors is the case, where errors at a single point in time, share a common component, e.g. the data measured in one year, is higher for all units. Autocorrelation means, that what happened at particular time can influence what will happen later, e.g. an event encountered in one region in one year, can influence efforts in the following year(s) in the same region. The last problem with panel data analysis is unit heterogeneity, i.e. the units are different from each other. Although all the regions are part of the same country, some departments can have different characteristics than others and these differences can influence the data.

To avoid these problems a linear mixed model option in the SPSS program will be used to analyse the data. Six models called A, B, C, D, E and F will be used. Model A is a regular regression model. The regression model does take into an account fixed effect for the independent variable. Model B will incorporate random intercepts for

each region. The last, model C, adds random slopes. Models D, E and F are analogical to A, B, C, but analyses the entire population. To compare the models, -2log likelihood will be used. Lowest value will indicate the best model. The last part of the analysis will add GDP as another predictor.

5.2. Results of the analysis

This section will present results of the analysis. The next chapter will provide a discussion of the results and will draw a conclusion based on the findings presented in this chapter. As statistically significant, all cases with significance coefficient lower than 0.05 are considered.

First, results for the effect on homicide rates are presented in **Figure 3**. The following **Figure 4** presents results for the model considering kidnapping rates as a dependent variable.

Figure 3: Summary of the results for dependent variable homicide rates.

Model	N = 6 (regions)			N = 23 (regions)		
	A	B	C	D	E	F
-2log likelihood	409,889	381,596	380,637	1538,932	1368,164	1358,151
Intercept	26,825*	53,245*	51,673*	37,25*	39,455*	37,724*
are	0,0055*	0,001	0,0008	0,0012*	0,0005	0,0009
std. error	0,0017	0,0011	0,0019	0,0006	0,0006	0,0017

* statistically significant results ($p < .005$)

Figure 4: Summary of the results for dependent variable kidnapping rates.

Model	N = 6 (regions)			N = 23 (regions)		
	A	B	C	D	E	F
-2log likelihood	239,319	231,503	227,078	988,772	968,168	957,987
Intercept	-1,391	-1,511	-0,735	2,237*	1,998*	2,181*
are	0,0008*	0,0008*	0,0007*	0,0001*	0,0002	0,0002
std. error	0,0001	0,0001	0,0002	0,000059	0,000083	0,0001

* statistically significant results ($p < .005$)

As can be seen, the value for -2log likelihood indicator is smallest for the C, respectively F model. In other words intercepts and random slopes of the each regions vary for the relationship between area under coca cultivation and homicide, respectively kidnapping rates. Hence the difference between individual regions is a factor, which can influence the analysis.

The estimated coefficients can be added to the **equation** (1). The following equations illustrate the outcome of regression analysis considering area under coca cultivation as the dependent variable. The following equations present coefficients of the best model, i.e. C, or F respectively. **Equations** (3) represents the relation for homicide rates and **equation** (4) kidnapping rates.

$$y_{6\text{hom}} = 51,673 + 0,0008x + u_{it} \quad (3)$$

$$y_{23\text{hom}} = 37,724 + 0,0009x + u_{it} \quad (3)$$

$$y_{6\text{kid}} = -0,735 + 0,0007x + u_{it} \quad (4)$$

$$y_{23\text{kid}} = 2,181 + 0,0002x + u_{it} \quad (4)$$

These equations indicate that the relationship between the area under coca cultivation and homicide, or kidnapping rates respectively is very small. A unit change in the area under coca cultivation is associated with a change of 0,0008 (taking into account top 6 region), respectively 0,0009 (considering all the 23 regions) in the homicide rate. The relationship is positive, i.e. an increase in the area under coca cultivation is associated with an increase in the homicide rate. The same applies to the second dependent variable - kidnapping rates. Here the change is even smaller. Specifically in the 6 regions unit increase in the area under coca cultivation is associated with 0,0007 increase in kidnapping rate. Considering all the 23 regions, the associated increase is only 0,0002.

Moreover, not all of these coefficients are statistically significant. Considering the model C and F, only coefficient associating a unit change in the area under coca cultivation with 0,0007 change in the kidnapping rate was statistically significant.

Figures 5 and **6** present results for the analysis including GDP per capita as another predictor. As can be noticed, model C (F respectively), i.e. models with random intercepts and slopes have the lowest -2 log likelihood values.

Figure 5: Summary of the results for dependent variable homicide rates.

Model	N = 6 (regions)			N = 23 (regions)		
	A	B	C	D	E	F
-2log likelihood	409,887	380,317	380,219	239,251	229,727	225,993
Intercept	26,444	69,442*	62,411*	-1,208337	0,330498	0,0395267
are	0,0056*	-0,00018	0,000151	0,000765*	0,000675*	0,000564*
std. error	0,001684	0,00144	0,001859	0,000126	0,000143	0,000215
gdp	0,000034	-	-	-0,000018	-0,000136	-0,000073
std. error	0,000774	0,000901	0,000857	0,000069	0,000094	0,000069

* statistically significant results ($p < .005$)

Figure 6: Summary of the results for dependent variable kidnapping rates.

	N = 6 (regions)			N = 23 (regions)		
	A	B	C	D	E	F
-2log likelihood	1518,873	1367,757	1349,397	988,771	955,036	941,045
Intercept	19,197036*	36,282438*	32,765547*	2,221586*	4,761433*	6,364310*
are	0,001707*	0,000733	0,000403	0,000150*	0,000137	0,000099
std. error	0,000529	0,000684	0,001075	0,00006	0,000098	0,000105
gdp	0,002045*	0,000311	0,000603	0,000002	-	-
std. error	0,000442	0,000471	0,000794	0,000052	0,000073	0,000123

* statistically significant results ($p < .005$)

The relationship (after including the GDP variable) are even weaker, than in the earlier case. **Equation (5)** and **(6)** represent the relationship. The earlier (**equation 5**) calculates homicide rates, the latter (**equations 6**) kidnapping rates.

$$y_{6\text{hom}} = 62,411 + 0,000151x_1 - 0,000679x_2 + u_{it} \quad (5)$$

$$y_{23\text{hom}} = \alpha_i + 0,000564x_1 - 0,000073x_2 + u_{it} \quad (5)$$

$$y_{6\text{kid}} = \alpha_i + 0,000403x_1 + 0,000603x_2 + u_{it} \quad (6)$$

$$y_{23\text{kid}} = \alpha_i + 0,000099x_1 - 0,000630x_2 + u_{it} \quad (6)$$

Coefficients in equations above are even lower than in the models without GDP variable. In some cases they report negative values. Most coefficients for GDP variable were negative. This suggests that there may be a negative relationship between the dependent variable and GDP in most cases, i.e. an increase in GDP could be associated with a decrease in homicide rates.

However the relationships is very weak. For example a unit decrease in the area under coca cultivation can be associated with a decrease by 0,000564 in homicide rate and a unit decrease of GDP per capita is associated with a 0,000073 increase in homicide rates considering all the regions. Corresponding results for kidnapping rate are 0,000099 decrease of kidnapping rate with a unit decrease in the area under coca cultivation and by 0,000630 with a unit decrease of the GDP per capita. On the top of the weak relationship, not all the measured values were statistically significant.

6. Conclusion

The analysis tried to answer the research question: "*can reduction in coca cultivation can be interpreted as successful in terms of stabilizing security situation in Colombia*"? If the objective of coca reduction efforts was to lower the violence and improve the security situation, the effort has failed to do so.

Decreasing levels of violence in Colombia are probably the result of a different effort or development not the effect of coca supply reduction. However, the analysis was based on a number of assumptions. Their violation could significantly threaten the results. The clandestine character of the cocaine industry can also pose a threat to the result, because the official data may be flawed. More data, in terms of precision as well as quantity, would enhance the validity of these findings.

For instance, the place of coca cultivation, cocaine production and violence may not be identical. If each of this activity is committed in different Colombian regions, results of this study could be significantly flawed. However, no data or research has been published to target this issue.

In summary, the study does not support claims that violence could be brought down through eradication of coca fields, or by providing alternative development programs with an objective to lower the existing area of the coca fields and other supply reduction programmes. This study is not denying the relationship between drugs and violence; it rather questions the relationship between reduction of coca fields and violence. The link between coca and violence is very complex and more research will be needed to fully understand what measures work the best.

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