THE EFFECTIVENESS OF CROP TARGETING INTERVENTIONS FOR DRUG CONTROL: A SYSTEMATIC REVIEW AND META-ANALYSIS

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ABSTRACT

Literature suggests that illicit crop eradication is not only the centrepiece of the supply-side campaign in the “war on drugs,” but a highly contested and controversial issue. Even with the re-positioning of the U.S. drug policy toward a combination of prevention, education, and smarter use of law-enforcement resources, drug policies throughout the world continue to include, and rely upon, law enforcement and supply-side reduction strategies. The sheer dominance of supply-side approaches to drug control policy suggests the timeliness of “taking stock” of what works in drug supply-reduction interventions. In this paper we detail the results of a systematic review and meta-analysis of the empirical literature evaluating the effectiveness of crop targeting as a drug control strategy. Our search identifies 15 studies that report an empirical impact evaluation of the effectiveness of crop targeting interventions in Afghanistan and Colombia. The interventions evaluated are crop eradication, agricultural assistance programs and awareness programs. We present the results of random-effects meta-analyses conducted on these studies, and discuss the impact of sources of heterogeneity, including intervention strategy and location. We find that eradication does not reduce cultivation but alternative development does. We discuss the policy implications of the research evidence to help inform the smarter use of scarce resources to control the supply of illegal drugs.

SOURCES OF SUPPORT:

Institutional support was received from the University of Queensland, Institute for Social Science Research (ISSR). External support from Drug Policy Modelling Program (DPMP), funded by the Colonial Foundation Trust and the Australian Research Council (ARC) Centre of Excellence in Policing and Security (CEPS).

ACKNOWLEDGEMENTS

The authors wish to acknowledge the assistance of members of the systematic review Advisory Group: Robyn Attewell, Anthony Braga, Simon Bronitt, Melissa Bull, Jonathan Curtis, Caitlin Hughes, Peter Reuter, Alison Ritter, Cody Telep, Damian Voltz, and Grant Wardlaw. We also wish to acknowledge the contributions of Adele Somerville, Kathryn Ham and Madonna Devaney to the searching, screening and coding of studies for this review, and to Michelle Sydes and Lacey Schaefer for research support.

STATEMENT CONCERNING CONFLICT OF INTEREST

None of the authors have any known conflicts of interest.

DRAFT: DO NOT CITE WITHOUT AUTHORS’ PERMISSION
INTRODUCTION

Law enforcement interventions that control the supply of drugs to illicit markets seek to reduce the availability of drugs in illicit markets, reduce the wealth and power of ongoing criminal organizations, and advance the foreign-policy objectives of countries, like the U.S., that currently invests around $2 billion dollars a year in off-shore drug control initiatives (ONDCP, 2012). One central off-shore drug control initiative of countries such as the US, UK, Canada and Australia is to target the crops used to cultivate illicit drug substances. Efforts to control the supply of plant-based substances to global drug markets began in 1909 and continue today as an important system of control (UNODC, 2008). Despite the re-positioning of the U.S. drug policy toward a combination of prevention, education, and smarter use of law-enforcement resources (Kerlikowske, 2011), drug policies throughout the world continue to rely upon supply-side reduction strategies.

This paper presents the results of a systematic review focusing on the impact of crop targeting efforts to control illegal drug supply at the wholesale level of the illicit drug supply chain. We begin by providing some background on crop targeting initiatives, identifying three broad categories of crop targeting initiatives: eradication, alternative development and awareness campaigns. We then detail the methodology for the systematic review and meta-analysis. We conclude by presenting the results of our review and discussing the implications for drug control policy.

BACKGROUND

Illegal drug use is a global public health problem with consequences for social and economic development. Recent estimates from the United Nations Office on Drugs and Crime (UNODC) estimate the global prevalence of illegal drug use at between 149 million and 272 million people per year, or 3.3 to 6.1 percent of the world’s population, and rising (United Nations Office on Drugs and Crime [UNODC], 2011). Illegal drug use results directly in almost 200,000 deaths per year (UNODC, 2011), and the indirect social and economic costs of the illegal drug trade are much greater. In 2011, the U.S. National Drug Intelligence Center estimated that the economic cost to the U.S. of illicit drug use was more than $193 billion during the 2007 calendar year. This estimate includes $61.4 billion in crime related issues, $11.4 billion in health related issues and $120.2 billion to loss of productivity (United States Department of Justice, National Drug Intelligence Centre, 2011). Research consistently shows a direct link between emerging violence and the illicit drug trade (International Centre for Science in Drug Policy, 2010). International implications of the drug trade include the establishment of international organised crime networks (Schneider, 2010), an escalation in violence along trafficking routes (UNODC & Latin America and the Caribbean Region of the World Bank, 2007), and increased corruption in federal law enforcement agencies (Bronitt, 2004; UNODC, 2007). In 2010 alone, the estimated number of deaths related to drug trafficking was 11,600, with an estimated 30,000 deaths occurring from December 2006 onwards (Trans-Border Institute, Justice in Mexico Project, 2010), highlighting the urgency of assessing the relative effectiveness of various drug-control strategies.
On February 28, 2011, U.S. Drug Policy Director Gil Kerlikowske described a repositioning of U.S. drug control policy to promote a more balanced approach than that of previous drug policies, combining prevention, education, and promotion of “smarter use of law enforcement resources” (Kerlikowske, 2011). This shift in U.S. drug policy marks the first major move away from the law-enforcement-dominated “War on Drugs” in decades. The “smarter use of law enforcement resources” comment by Kerlikowske serves as a reminder that supply-side, law-enforcement approaches to drug control should be evaluated for their effectiveness before being included in future portfolios of drug control interventions not just in the U.S., but also elsewhere in the world.

Drug law-enforcement strategies target all parts of the supply chain, from actions aimed at preventing importation across national borders (Wood et al., 2003) to those that target the point of supply to consumers (Ministerial Council on Drug Strategy, 2011). Yet despite the obvious interconnections between supply, demand and harm reduction strategies, many countries throughout the world treat demand, supply and harm reduction approaches as independent efforts, or “silo-ed pillars,” for preventing and controlling illicit drugs (Caulkins, 2002; Pentz, Bonnie, & Shopland, 1996; Ritter, Bammer, Hamilton, Mazeroile, & DPMP Team, 2007; but see Hughes, Lodge, & Ritter, 2010). Supply reduction is generally defined as strategies and actions which “prevent, stop, disrupt or otherwise reduce the production of supply of illegal drugs as well as efforts to control, manage and/or regulate the availability of legal drugs” (Collins & Lapsley, 2008; see also Fisher, 2009b; McSweeney & Turnbull, 2011). In contrast, demand reduction is defined as “strategies and actions which prevent the uptake and/or delay the onset of use of drugs; reduce the misuse of drugs in the community; and support people to recover from dependence and reintegrate with the community” (Ministerial Council on Drug Strategy, 2011; see also Clark & Fisher, 2009; McSweeney & Turnbull, 2011). Harm reduction, by contrast, seeks to reduce the adverse health, social and economic consequences of the use of alcohol, tobacco and other drugs (Caulkins & Reuter, 1997; Fisher, 2009a; McSweeney & Turnbull, 2011; Ministerial Council on Drug Strategy, 2011).

Despite a wealth of empirical evidence demonstrating the (in)effectiveness of varying approaches to drug control, United States drug policies have remained politically polarized for decades. Yet, while there is a growing acknowledgement that the United States cannot arrest its way out of their drug problem, this attitudinal shift is only slowly being reflected in budget allocations (Kilmer et al., 2012; Office of National Drug Control Policy, 2012). Liberal perspectives favoring drug prevention and treatment have popularized in the most recent generation, although Nixon- and Reagan-era policies aimed at interdiction and enforcement continue to occupy the majority of federal drug control spending (Office of National Drug Control Policy, 2012; Reuter, 1997). A host of conservative crime control policies accompanied the introduction of the “war on drugs,” and these tough-on-crime initiatives are generally regarded as failing to save resources or enhance public safety (Global Commission on Drug Policy, 2011). Irrespective of these findings, the ideologies that are appended to U.S. drug policy continue to receive constituent support (Huggins, 2005). This has resulted in drug control funding that is primarily aimed at supply reduction (Carnevale & Murphy, 1999), with three approaches dominating the policy landscape (Kilmer, Caulkins, Pacula, & Reuter, 2012). First, United States drug policy emphasizes domestic law enforcement with impressive scale and punishment (Reuter, 1997). Second, as these zero-tolerance policing strategies failed to produce the desired outcomes, efforts aimed at interdicting drug supplies increased substantially. The methods through which drugs are
seized prior to reaching their target destination are varied; techniques of surveillance and apprehension are continually changing, as the couriers and vessels used by smugglers and traffickers are likewise frequently revised (Kilmer et al., 2012). Third, international law enforcement has oriented itself toward *crop eradication* and corresponding military and economic interventions (see Farrell, 1998).

The US National Drug Control Budget for supply reduction activities has remained relatively steady at approximately $15 billion (approximately 59%) per year for the last 3 financial years; however the 2013 allocation for international drug control activities ($1,962 million) has seen a 6% decrease from FY 2012 levels (ONDCP, 2012). The budget includes allocations of $653.3 million to Afghanistan and Central Asia to support counter-narcotics activities\(^1\) and $114 million to support Colombian-led interdiction, eradication and security\(^2\) (ONDCP, 2012). In contrast, the United States Agency for International Development (USAID) has been allocated $179.1 million\(^3\) for alternative development programs that aim to divert farmers from illicit crop production (ONDCP, 2012).

The UNODC lists the world’s main drug growing countries as Colombia, Peru and the Plurinational State of Bolivia (coca), Afghanistan, Mynanmar and The Lao People’s Democratic Republic (opium) and Morocco (cannabis) (UNODC, 2013). Afghanistan is responsible for 90 per cent of global opium output with an estimated 131,000 hectares under opium poppy cultivation in 2011 (UNODC, 2013). According to UNODC (2013), Myanmar is the second largest opium grower; in 2011, the area under opium poppy cultivation in Myanmar was estimated at 43,600 hectares. Mexico is the world’s third largest cultivator of opium poppy with approximately 19,500 hectares under cultivation in 2009 (UNODC, 2013). In terms of coca cultivation, Colombia is the world’s largest grower with an approximated 62,000 hectares under cultivation in 2010, and Peru is the world’s second largest coca bush grower, with an estimated of 61,200 hectares was under coca bush cultivation in 2010 (UNODC, 2013). The third largest coca bush grower in the world is the Plurinational State of Bolivia with around 31,000 hectares under cultivation in 2010 (UNODC, 2013).

Whilst acknowledging the difficult task of estimating government drug policy expenditures (see Reuter, 2006), research consistently shows that the big ticket item in drug control expenditures is law enforcement supply-reduction strategies (Caulkins & Reuter, 2010). In Australia, the law enforcement slice of the drug policy expenditure pie is approximately $740.4 million per annum (Moore, 2005). Efforts to control supply to global drug markets began in 1909 and continue today as an important system of control (UNODC, 2008). This demonstrable, unequivocal and sheer dominance of supply-side approaches to U.S. drug

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\(^1\) The FY 2013 level of funding to Afghanistan and Central Asia is a $72.5 million increase over FY 2012 (ONDCP, 2012).

\(^2\) FY 2013 funding allocations to Colombia represent a decrease of $16.4 million from FY 2012, largely as a result of the Colombian governments’ success in nationalising the Colombian Army Aviation and Counterdrug Brigade programs (ONDCP, 2012).

\(^3\) The FY 2013 funding represents a decrease of $102.4 million since FY 2012, largely due to increased Colombian self-sufficiency in this regard (ONDCP, 2012).
control policy suggests the timeliness of “taking stock” of what works in drug supply-reduction interventions.

Literature suggests that illicit crop eradication is the centrepiece of the supply-side campaign in the “war on drugs” (James, 2005). Techniques for reducing cultivation vary according to the crop involved, yet typically include three broad categories: eradication, alternative development and awareness campaigns.

**Crop Eradication**

In Afghanistan, in 2009, methods of opium poppy eradication in Afghanistan included tractors (59%), manual tools (38%) and animal plough (3%) (UNODC, 2009). Methods utilized for coca eradication in Colombia include mechanic and manual destruction (plant by plant), aerial or manual spraying, burning and the use of biological means (UNODC, 2006). Coca is harder than most other crops and can grow on poor quality or depleted soil and is resistant to climate variations and pests (Dion & Russler, 2008). The most commonly used method has been aerial fumigation and supply reduction programs under Plan Colombia (Dion & Russler, 2008).

**Alternative Development**

In contrast to crop eradication are drug control programs that provide agricultural and developmental assistance. These types of program rely less on direct eradication of crops and more on addressing the economic and development issues that encourage the farming of illicit crops. This assistance can be in the form of medicine, education, construction activities, electricity, drinking water and agricultural inputs (UNODC, 2007a). In Afghanistan in 2007, 83% of villages reported receiving external assistance, the majority of which was from the government (64%), the United Nations (21%), and non-government organisations (14%) (UNODC, 2007b). However, in 2009, the number of villages receiving agricultural assistance had reduced to 33% (UNODC, 2009).

**Awareness Campaigns**

Anti-opium awareness campaigns is another form of crop targeting initiatives that have taken place in many Afghan provinces over recent years. Public awareness campaigns in Afghanistan highlight the harms of opium whilst promoting alternative livelihoods. According to Lipetz (2007), many Afghans view opium in a positive light due to its economic usefulness, demonstrating a need to educate the population regarding the negative impact of opium. To be successful, awareness campaigns need to tap into the Afghan psyche by emphasising that opium is illegal, injurious and most importantly un-Islamic, and for all parties involved with delivering the anti-opium message to the public to be transparently at arms’ length from all illegal drug activity (Lipetz 2007).

In this paper, we present results from a systematic review and meta-analysis of the effectiveness of crop targeting interventions to control illegal drug supply at the wholesale level of the illicit drug supply chain. Our review is timely, given the rationalizations in supply-side interventions accompanying the recent shift in U.S. drug policy. Our systematic review seeks to provide policy makers with the research evidence to help guide a smarter use of scarce law enforcement resources aimed at the wholesale level of efforts to control the supply of illegal drugs.
OBJECTIVES

The key objective of this review is to systematically assess and synthesize all available research that evaluates the effectiveness of crop targeting as a drug control strategy to reduce the wholesale supply of illicit plant-based drugs. In this paper we present preliminary results from the review, examining the effectiveness of crop eradication, agricultural assistance and awareness campaigns as strategies to reduce the wholesale supply of illicit plant-based drugs.

METHODOLOGY

We utilise a systematic review methodology (see Cooper et al, 2009). A systematic review is a robust and transparent framework for synthesising empirical evidence of the effectiveness of interventions that involves a methodical search for all published and unpublished reports, a clear set of inclusion and exclusion criteria, a transparent and replicable coding framework, and the use of meta-analysis to statistically synthesise the research evidence. In this way, a systematic review provides a reliable and defensible evaluation of existing research evidence. The review methodology is set out in detail below.

Our review has been registered with the Campbell Collaboration (Mazerolle et al, 2012). The Campbell Collaboration is an international collaboration of researchers, policy makers and practitioners that supports well-informed decision-making through the preparation, maintenance and dissemination of systematic reviews in education, crime and justice, international development, and social welfare. Registering the review with the Campbell Collaboration ensures our work is subject to rigorous peer review and that the research is available to decision-makers internationally.

CRITERIA FOR INCLUSION AND EXCLUSION OF STUDIES IN THE REVIEW

Types of Interventions

To be eligible for inclusion in the review, studies must have examined the effectiveness of a crop targeting strategy aimed at controlling the supply of illicit, plant-based drugs. For the purpose of our systematic review, crop targeting interventions are defined as interventions aimed at reducing the supply of drugs through destroying or suppressing the development of illegal drug crops. Interventions that involve crop targeting and explicitly state that the initiative, program, policy, or legislation are aimed at managing, reducing, removing, curtailing, stopping or eradicating illicit plant based drug crops will be included. These interventions can directly effect the removal of an illicit crop (eg crop eradication) or indirectly effect the removal by providing education or assistance to farmers to desist from cultivating illicit crops (eg awareness programs and agricultural assistance or alternative development programs).

An example of a wholesale level crop targeting initiative is Plan Colombia, a Colombian and U.S. effort to reduce the supply of illegal drugs entering the U.S. market (Veillette, 2005). With U.S. support through the State Department’s Office of Interregional Aviation, the initiative involved aerial eradication through the spraying of coca and poppy crops with a glyphosate herbicide mixture (Veillette, 2005).
The drugs that are considered in crop targeting interventions are all drugs that are illegally grown and cultivated according to international agreements and local (national) laws. Such plant-based substances could include cannabis, coca and the opium poppy. The drugs must be plant-based, thus any illicit drugs that are chemical based will be excluded from the review. We do not include interventions that seek to eradicate precursor chemicals (non-plant based) used to create illicit drugs unless the strategy relates to crop targeting as a drug-control strategy. To be included in our review the “crops” must involve the yield of any illicit drug. Crops that produce illegal weeds or plants that do not fall under this category are omitted.

We only include crop targeting activities that operate at the wholesale level of drug activity. We recognize the different market levels in which the problems of illicit drug activities take place, from activity at the wholesale end of the supply chain through to the street level (or retail level) of the supply chain (see Bright & Ritter, 2010). A wholesale, or commercial activity, involves any method of generating the supply of the illegal substance itself (production and manufacture) and distributing it amongst the lower levels of the pyramid. The Australian Criminal Code Act 1995 defines the term “supply” to include the following: supply, whether or not by way of side; and agree to supply (Criminal Code Act, 2011). This wholesale level is where our notion of “crop targeting” is introduced and where importation/exportation of illegal substances occurs, for large quantities of money. Sometimes it can be hard to distinguish between the different levels of drug activity, and penalties that apply to such activity. The guidelines for how law enforcement agencies define these levels of activity vary by country. In Australia, for example, laws relating to any plant of the genus cannabis are covered in the Criminal Code Act 1995 stating that if a person is caught with 250g or 10 plants, this is defined as a trafficable quantity (users and distributors); 25kg or 100 plants is defined as a marketable (distributers and suppliers) quantity; and the commercial (suppliers) quantity is 250kg or 1,000 plants (Criminal Code Act, 2011). In the U.S., drug trafficking penalties are also defined by the quantity. Penalties for trafficking marijuana range from not more than 5 years imprisonment for 1 to 49 plants (less than 50kg), to not less than 20 years imprisonment, and no more than life, for 1,000 or more plants (1,000kg) (United States Drug Enforcement Administration, 2012). Regardless of the country, these guidelines aid in effectively determining the level of drug activity. We use these legal definitions in our review to focus on crop targeting interventions at the most serious, wholesale stage in the drug supply chain.

Crop targeting activities that focus on alternative development assume that “drug problems are closely linked to development problems and that effective development policy measures can bring about a sustainable reduction in drug cultivation” (Berg, 2002, p. 1). Berg argues that alternative development policies aim to create economic and social conditions in which households can achieve an acceptable standard of living without having to resort to drug cultivation. In Thailand, for example, alternative development projects played a major role in reducing opium production from 146 to 6 tonnes between 1968 and 2000 (see Berg, 2002).

**Types of Studies**

To be included in our review as a high quality study, studies must use a quantitative evaluation design, with a valid comparison group. Eligible designs include randomized trials, natural experiments, time-series designs, regression discontinuity designs, and any quasi-experimental design with a matched or non-matched comparison group, including matched
comparison groups, propensity score matched comparisons, and post-hoc statistically matched comparisons.

We recognize that because crop targeting interventions are a part of established government drug control policy, they can therefore be considered the business-as-usual treatment; consequently there may be very few high quality studies where crop targeting interventions are assessed against a control group. We acknowledge that many evaluations may be in the form of time-series designs, and may not include a valid comparison group. We therefore include time-series pre–post test evaluations without a comparison group in our review, as well as correlation designs without comparison groups; however, we note that the quality of these studies may be lower than that of studies that include a valid comparison group, and in the final review we will conduct sub-group analysis using study quality as a predictor variable.

We include evaluations where the comparison group is business-as-usual, or no intervention, but not where two treatments are compared with no baseline business-as-usual comparison, as these types of design are highly subject to bias.

**Types of Participants**

The units of analysis in the search are any geographic place (e.g. province, state, region, country or countries) that is the subject of crop targeting interventions. In order to obtain an accurate global overview of the effectiveness of crop targeting as a strategy for drug control, there are no geographic limitations for inclusion.

**Types of Outcome Measures**

The search includes interventions which deal with some outcome measure of drug production, prevalence and availability of the drug on the illicit market are included in the review, including: consumption, production, cultivation, yield, net farm income, market availability and number of eradicated hectares. In the final review we will differentiate between effects measured at the local and at the global level in our analyses.

Figure 1 below provides a Logic Model to help guide the review. The logic model presents a simplified, graphical interpretation of the logic of intervention effectiveness. The boxes and arrows represent interventions, outcomes and relationships that exist in the overall logic of crop targeting as a drug control strategy. As this logic model shows, the primary goal of the interventions is to reduce the supply of illegal drugs. By implementing crop targeting initiatives such as eradication and substitution, various direct (proximate) outcomes are produced. For the final review we will code a range of direct and indirect outcomes. Direct outcomes include: seizure rates, production rates, consumption, cultivation, yield, net farm income, and the number of eradicated hectares. As demonstrated in the far right box, indirect outcomes could include: violence, economic, harm, or unintended outcomes such as displacement of drug cultivation.
Figure 1. Logic model of interventions involving crop targeting as a strategy for drug control

Exclusion criteria

Since we are focusing primarily on the reduction of drug supply through crop targeting, any evaluation of interventions that are not directed at plant-based drugs and targeted toward activities to reduce/eliminate crops are not included in the review.

We also exclude all of the street-level drug law-enforcement interventions included in Mazerolle and colleagues' earlier review of “street-level drug law enforcement” (Mazerolle et al., 2007). Interventions such as community-wide policing, problem-oriented policing and hotspots policing are all excluded unless the evaluation explicitly states that the intervention approach is aimed at the wholesale level of the market and used to target crop cultivation activities.

Settings and Timeframe

We only include documents produced after 1 January 1980. We do not limit the country or region where the intervention was staged.

SEARCH STRATEGY FOR IDENTIFICATION OF RELEVANT STUDIES

A list of preliminary search keywords was developed to cover four key categories: primary intervention; intervention; outcome; and substance. The primary intervention keywords ensure that the intervention of interest is applied to crops. The intervention keywords capture the variety of crop interventions that take place, and narrow the focus of the search onto interventions designed to destroy or target crops, or capture a law enforcement aspect of the document. The outcome intervention keywords ensure that the intervention is measured by its effect on the market. The substance keyword ensures that the document is focused specifically on illicit plant-based drugs. The search strategy combines the sets of keywords with a Boolean AND.
1. Primary intervention

CROP or CROPS

2. Intervention

“ALTERNATIVE DEVELOPMENT” or “ALTERNATIVE CULTIVATION” or ERADICATION or SUBSTITUT* or TARGET* or “LAW ENFORCEMENT” or CONTROL or POLICY

3. Outcome

CONSUMPTION or SEIZURE* or MARKET* or PRODUCTION or CULTIVAT*

4. Substance

“ILLICIT DRUG*” or CANNABIS or MARIJUANA or COCA or COCAINE or OPIUM or POPPY

This list was generated using Leximancer text analytic software (available from https://www.leximancer.com). Using a list of keywords derived from reading background literature, we ran a search on the Web of Knowledge and Scopus databases. We sorted the results according to relevance and selected the first 100 from each database (with abstracts, if available). These articles were fed into Leximancer, which generated a list of themes and concepts pertinent to the body of texts. From Leximancer, we took the top ten themes and concepts, as well as other concepts that we thought relevant, to arrive at a list of initial keywords. Certain broad concepts, such as “plant” and “drug”, were removed in order to make the keyword search more topic focused. A comparison of the results from our initial keyword search in Web of Knowledge with the keywords formulated from the Leximancer keywords found that a small number of texts were missed by the Leximancer keyword search. Examination of these texts resulted in the addition of “alternative cultivation” to the list of keywords, and the use of wild card notation to “substitution” (substitut*).

The list below shows the databases and websites searched for the review:

- American Physical Society
- Australian Criminology Database (CINCH)
- DOAJ
- DrugData
- EconLit
- GPO (U.S. Government Publications)
- Humboldt
- Informit
- JSTOR
- Maney Publishing
- MIT OpenCourseWare
- NDLTD
- PolicyFile
- ProQuest
- ProQuest Digital Dissertations index
In order to maintain an accurate list of search keywords, a pilot search was conducted so that any modifications to the list could be made prior to commencing the systematic search.

After the initial list of eligible documents was identified, we searched the reference lists of all eligible documents. Newly identified documents then went through the title and abstract screen, document retrieval and document coding stages. This iterative process continues until no further new documents are identified.

For the final review, the list of eligible studies will be sent to the project Advisory Group to determine whether or not we missed any important sources. Furthermore, the authors of the included studies will be sent the list and asked for recommendations for further sources.

Once the initial search was completed, duplicate records were removed, and the bibliographic details of each potentially eligible document were exported to an MS Access database at the University of Queensland.

**Title and abstract screening**

The aim of the title and abstract screening stage of the review process was to assess document titles and abstracts for eligibility, and to screen out documents which have been captured in the keyword search but are not relevant to the review. At this stage, the screeners were presented with the bibliographic details of each document, which may also include an abstract if the indexing database allowed abstract export. If the document was in a non-English language, we used Google Translate to provide a translation of the title and abstract.

To be eligible for inclusion at the title and abstract screen stage, the study must have exhibited the following two characteristics:

1. The document related to some kind of illicit, plant-based drug. Studies relating to any form of chemical-based drug were immediately excluded.

2. The document related to some form of “crop targeting” activity. At this stage the precise details of the activity are not necessarily available, so we include any form of crop activity that aims to reduce/control the supply of the illicit substance.
Three trained research assistants conducted the title and abstract screening process, using the “Crop targeting review title and abstract screen coding companion” document (Appendix A).

**Document retrieval**

Once the documents were screened and a list of potentially eligible documents were obtained, the next stage was to retrieve the documents. Electronic copies of documents were attached to the document record in the database, and hard-copy versions of documents were retrieved through the University of Queensland library.

**Study coding**

Three trained research assistants coded the documents using the “Crop targeting review coding sheet companion” (Appendix A). Each coder first coded a selection of 15 documents for eligibility and issues of inter-coder agreement were addressed if required.

Documents were read in detail and coded according to document eligibility, study information, intervention information, implementation success, quality, authors’ conclusions, and outcomes. Each document may contain multiple studies which may in turn report on multiple outcomes. The coding database captures this nested data arrangement. Details of coding fields are contained in Appendix A.

As a quality control measure, all documents which were coded as eligible for meta-analysis had their coding double-checked by a second coder.

**Statistical procedures and conventions**

We used meta-analysis to synthesize the results of the included evaluations. Effect sizes were calculated using Comprehensive Meta-Analysis software. We used a random-effects model to combine study results, given the heterogeneity in the interventions and populations studied. In the full review we will examine sources of heterogeneity in the intervention impact, including intervention strategy, location, implementing agency, population under study, and evaluation quality using subgroup analysis (analogue to the ANOVA) for categorical outcomes and meta-regression for continuous predictors. If the analysis shows significant heterogeneity of effects across locations, we will display this effect graphically in a series of maps to inform interpretability of the results.

We tested for publication bias using a range of approaches suggested in Rothstein, Sutton, and Borenstein (2005); including funnel plots and trim-and-fill analysis. We used Comprehensive Meta-Analysis software for calculations and production of figures.

**RESULTS**

**Selection of studies**

The initial search of databases and grey-literature yielded a total of 20,287 documents. Of these documents, 539 were considered potentially eligible for inclusion after title and abstract screening. Of the rejected documents, 19,793 did not relate to plant-based illicit drugs and 20,020 did not relate to crop targeting interventions. Inter-rater agreement was
calculated for a random sample of documents, resulting in over 98% agreement for document eligibility.

Of the 539 documents screened as eligible for detailed coding, only 16 met the criteria for eligibility as impact evaluation studies. The results of the evaluations reported in the 15 documents that evaluate the effect on crop cultivation are synthesised in this review⁴. Details of these 15 eligible impact evaluation studies are listed in Appendix B.

**Characteristics of included studies**

*Study locations and crops targeted*


*Intervention strategies*

The intervention strategies in the included studies were: crop eradication (n=10), agricultural assistance (n=10) and awareness campaigns (n=4).

Crop eradication interventions conducted in Afghanistan predominantly used tractors, manual eradication and animal ploughs. Eradication interventions in Colombia is predominantly aerial or manual spraying, mechanical or manual destruction, burning or biological control, with aerial spraying the most commonly used method.

Agricultural and developmental assistance in Afghanistan largely consists of medicines, education, construction activities, agricultural inputs, electricity and food assistance. Only one study in Colombia reported on agricultural assistance.

Anti-opium awareness campaigns in Afghanistan focus on the harms of opium and highlight alternative livelihoods. None of the studies report on awareness campaigns in Colombia.

*Publication status*

Only two documents were published in academic journals. Ten documents were produced by the United Nations Office on Drugs and Crime (UNODC), one was an academic conference paper, one was a publication from El Centro de Estudios sobre Desarrollo Económico (CEDE) at the Universidad de los Andes, and one was a PhD dissertation.

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⁴ A further 129 documents were identified as “process evaluations with data”. These documents report time series tables for various aspects of crop targeting activities (such as number of hectares eradicated, cultivation, and yield); however they report the various inputs and outcomes separately without assessing the relationship statistically, so cannot be considered an impact evaluation. The vast majority of these documents come out of the United Nations Office on Drugs and Crime. These documents will be assessed in the future, pending funding. They are not included, however, in the present review as they do not provide an estimate of an effect size. One document is excluded from analysis in this paper as it only reported on violence as an outcome.
Research designs

Three studies used a multiple regression design using number of hectares eradicated and number of hectares cultivated, observed over a series of years. Twelve studies used an unmatched control design where the control was villages that had not had an intervention in the previous year. Data for each of the studies was originally sourced from UNODC surveys or aerial surveys of cultivation.

Outcomes reported

None of the included studies directly assessed the impact of crop targeting interventions on the amount of the illicit drug that reached the wholesale market, or effects on the wholesale market overall. Fifteen documents reported on illicit drug crop cultivation as an outcome. One document reported on violence as the only outcome, and has not been included in the analyses for this paper. Five studies examined the area of land under illicit crop cultivation, whilst the majority of studies (n=10) operationalised cultivation dichotomously, measuring whether villages had cultivated (n=7) or intended to (n=3) cultivate illicit drugs in a given year. Issues with this method of measurement are discussed in more detail below.

Meta-analyses

Effect sizes were extracted from the studies that report the effectiveness of crop targeting on crop cultivation, and these effect sizes are combined using random effects meta-analysis. We present results for each outcome below.

Eradication

Ten studies report on the effect of crop eradication on the cultivation of illicit drugs. Figure 1 shows the results of the random effects meta-analysis of these studies. Seven of these studies individually report a significant increase in cultivation after eradication efforts, two show no effect and one shows a significant reduction. Overall, the combined effect of the interventions is a significant increase in cultivation after eradication (g=0.360, p<0.05).

Impact of eradication on cultivation

<table>
<thead>
<tr>
<th>Paper</th>
<th>Outcome</th>
<th>Timeframe</th>
<th>Hedges's g and 95% CI</th>
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<tr>
<td>Moreno-Sanchez et al (2003)</td>
<td>Cultivation</td>
<td>1988-2001</td>
<td>3.632 0.758 0.574 2.147 5.118 4.793 0.000</td>
</tr>
<tr>
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<td>Cultivation</td>
<td>1998-2002</td>
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<tr>
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<td>Cultivation</td>
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<tr>
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Figure 1. Results of meta-analysis of the impact of eradication on cultivation
Agricultural assistance

Ten studies report on the effect of agricultural assistance or alternative development on the cultivation of illicit drugs. Figure 2 shows the results of the meta-analysis of the studies reporting the impact of agricultural assistance on illicit crop cultivation. Five studies individually show a decrease in cultivation following agricultural assistance, one shows a significant increase, and two show no effect. When combined in a random effects meta-analysis, the overall effect seen is that agricultural assistance interventions result in significantly reduced cultivation ($g=-0.211, p<0.05$), which is in stark contrast to the effect of crop eradication interventions.

Impact of agricultural assistance on cultivation

<table>
<thead>
<tr>
<th>Paper</th>
<th>Outcome</th>
<th>Statistics for each study</th>
<th>Std diff and 95% CI</th>
<th></th>
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<tbody>
<tr>
<td>Tabares &amp; Rosales (2005)</td>
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<td>Cultivation 2012</td>
<td>-0.211</td>
<td>0.084</td>
<td>0.007</td>
</tr>
</tbody>
</table>

Figure 2. Results of meta-analysis of the impact of agricultural assistance on cultivation

Awareness campaigns

Four studies report on the effect of awareness or prevention campaigns on the cultivation of illicit drugs. All of these studies were undertaken in Afghanistan. Results of the meta-analysis are shown in Figure 3. Although two studies individually demonstrated a significant reduction in cultivation due to awareness campaigns, one showed no effect and the final study showed a significant increase in cultivation. The synthesised result shows no significant ($g=-0.289, p=0.162$). However, the study reported in UNODC (2009b) does indicate that in that year the assignment of villages to awareness campaigns was not random, as some villages that had never grown opium were included in the reported results but were never allocated to the intervention group. This could conceivably bias the results towards increased cultivation as a result of the intervention. Indeed, this is the only year where the results demonstrated increased cultivation due to awareness campaigns.
Impact of awareness campaigns on cultivation

Moderator analyses

As discussed above, the studies measure cultivation in two different ways. Cultivation can be measured as the area under cultivation, in hectares or km², or it can be measured dichotomously: whether the village cultivated or intended to cultivate illicit drug crops in a given year. The potential impact is that studies that measure cultivation dichotomously do not capture changes in the level of cultivation within a village. This measurement metric will only capture an effect if all cultivation in a village desists or if new cultivation begins in a village that previously had no illicit drug crop cultivation whatsoever.

Unfortunately, the metric of measurement is confounded with country and crop, as all the studies in Afghanistan measured the cultivation of opium (n=9) and cannabis (n=1) dichotomously and all the studies in Colombia measured the cultivation of coca (n=5) using area. It is therefore not possible to disentangle the effect of country and measurement metric in this analysis. Acknowledging that these effects are intertwined in the studies, for simplicity we will assess the moderator effect of country of intervention.

Figure 4 shows the results of the meta-analysis of eradication interventions when moderated by country of intervention. Here we see that eradication interventions in Afghanistan show no effect (g=0.160, p=0.448), whereas eradication interventions in Colombia show a significant increase in cultivation (g=0.496, p<0.05). Recall that this effect may be due to the metric of cultivation, whereby studies that measure cultivation by area (Colombia) show a significant increase in cultivation, whereas studies that measure cultivation dichotomously (Afghanistan) show that there is no effect on cultivation or the intention to cultivate illicit crops as a result of previous eradication interventions. There is, however, some indication of a trend over time in the Afghanistan studies towards an increase in cultivation as a result of eradication.
DISCUSSION

The systematic review resulted in the identification of 15 studies that quantitatively assessed the impact of crop targeting interventions on illicit drug crop cultivation. Results of meta-analyses indicate that crop eradication leads to increased cultivation, agricultural assistance leads to decreased cultivation, and there is no significant effect for awareness campaigns.

We recognise that crop eradication is part of a larger framework of supply reduction techniques, including social programs, capacity building and assisting partner nations to develop law enforcement and judicial capacities. Although our search strategy aimed to locate evaluations of interventions that targeted the cultivation of illicit drug crops, we did not search exclusively for crop eradication interventions. Indeed, we specifically extended the search to include interventions that addressed the social and economic issues that foster illicit drug cultivation. Despite an extensive search, only a limited number of impact evaluations were found and these focused on crop eradication, alternative development in the form of agricultural assistance, and awareness campaigns. Larger, macro level, social initiatives have not been quantitatively evaluated in the literature, and could therefore not be included in our analysis. The evaluations included in this analysis do not quantitatively evaluate any unwanted effects of the interventions such as spatial displacement of drug crop activity, increases in violence in response to eradication efforts, environmental damage to arable lands, or the social and economic effects of the loss of drug crop income to farmers. The located studies only speak to the effectiveness of the interventions that have been evaluated.

The synthesis of research evidence indicates that agricultural assistance programs do reduce future drug crop cultivation. In contrast, the empirical evidence indicates that, overall, there is no demonstrated reduction in cultivation as a result of interventions that use crop eradication, be that manual, mechanical or chemical. Indeed, this analysis
demonstrates that, overall, there is a significant increase in illicit drug crop cultivation as a result of eradication interventions. The effect does vary somewhat between countries. There is no evidence of any significant change in cultivation due to the eradication of opium poppies in Afghanistan; however, the studies examining the impact of coca eradication in Colombia indicate that eradication is related to an increase in cultivation. Recall that the country of intervention, crop type and metric of measurement for cultivation are all confounded. This confound makes the interpretation of the difference between countries problematic. We suggest that there are several alternate explanations for the difference in impact of eradication interventions. The evidence indicates that eradication leads to increased cultivation in Colombia, but not in Afghanistan. This effect may be genuine, it may be an artefact of the crop type, or it may be an artefact of the measurement technique.

There may be a genuine increase in illicit drug crop cultivation in Colombia and no effect on cultivation in Afghanistan. This may be due to the different natures of the two countries, or it may be an artefact of the drug type cultivated. Our findings indicate that there is a measurable rebound in coca cultivation but not in opium cultivation. A rebound effect may be seen after eradication interventions because farmers make an economic decision to increase planting in anticipation of future losses from eradication. If farmers wish to compensate for losses to drug crops after an eradication event, those farming coca may need to plant more bushes, whereas those farming opium poppies may only need to be more efficient in their future harvesting. This is consistent with suggestions that opium farmers can be resilient to some degree of eradication, by lancing the remaining poppies more times than they would otherwise, thus recouping some of their loss and not requiring them to plant additional crops to compensate for eradication. As a general rule, each opium poppy capsule is lanced between three to four times but can be lanced up to six times (Kapoor, 1995). In contrast, coca farmers would need to plant additional crops to anticipate future eradication if they wished to maintain their livelihoods. While aerial fumigation effectively destroys the coca harvest, the coca bush itself survives and therefore farmers are able to produce a new harvest within three to six months (Diaz & Sanchez, 2004). Within as little of six months of planting, coca can produce an initial harvest; however, in order to compensate for a three to six month crop shortage, farmers may plant additional crops after eradication interventions.

An alternate explanation is that effect that we see in our moderator analysis may be due to the metric of cultivation. Studies that measure cultivation by area (Colombia) show a significant increase in cultivation, whereas studies that measure cultivation dichotomously (Afghanistan) show that there is no effect on cultivation as a result of previous eradication interventions. It may be that eradication increases the area under cultivation in both countries, but the dichotomous nature of the Afghanistan data is not sufficiently nuanced to capture this effect. However, it is equally plausible that in Afghanistan, villages are reducing their crop after eradication and that this effect also cannot be picked up due to the metric used, as an effect would only be seen if the village completely desists from cultivation.

This systematic review of the effectiveness of crop targeting interventions provides a synthesis of all available research that has quantitatively evaluated the impact of crop targeting on the supply of wholesale illicit plant-based drugs. Whilst there is an enormous body of work that examines and evaluates the process of crop targeting, very few studies have performed rigorous impact evaluations. This small corpus of impact evaluations is not necessarily representative of all research, and indeed, may show results at odds with other
literature. However, we argue that the synthesis of impact evaluations provides a small, but strong, evidence base through which to assess drug control policy. We argue that there is no equally strong corpus of quantitative studies that indicate that crop eradication programs are successful, and that this systematic review and meta-analysis should be used to promote policy conversations about the relative effectiveness of eradication and alternative development. Our final and perhaps most pertinent point is that we call on researchers to perform more impact evaluations that can be added to this body of work, so that the policy considerations can be informed by the most rigorous empirical evidence.
REFERENCES


APPENDIX A: CODING GUIDE FOR DATA EXTRACTION

Use this document together with the review title registration/protocol to help you fill out the coding form on the database.

Before coding

1. Open the Crop Targeting database at S:\Policing and Security\Projects_ACTIVE\DPMP Drug Policy Modelling Program\Transborder Drug Ctrl Systematic Review\Crop Targeting review\Document Coding\Screening and coding database\Crop targeting Descripcoding v2
2. There are two forms for coding – “Coding systematic search docs” is the form for coding documents deemed potentially eligible from our systematic search. “Coding hand searched docs” is the form for coding documents picked up manually. Otherwise, the forms are identical.
3. The form is divided into two main areas – the top section relates to the document as a whole and the sub-form relates to each individual study in the document.
4. Note that documents can report on multiple studies and that studies can report on multiple outcomes.
5. The form should either display an icon in the PDF button on the top left, or indicate that the document needs to be ordered. For documents with a PDF icon, double-click on the PDF icon at the top left and select an attachment to open. For documents that were ordered, check if the document has arrived and if so, use the physical copy.
6. The first 6 fields of the form are not editable, but provide information on the document to be coded.
7. Coding begins at “Coder”
8. Start coding the document using the guidelines below.
9. Note: if you cut and paste information from the source document, please paste the text in between “ ” so that we do not accidentally plagiarise a document when summarising.

Coder

Select your name from the drop down list

Date coded

Click in this field for today's date

Document Eligibility

These questions determine whether the document is eligible for inclusion in the systematic review. The answers to these 5 questions combine to automatically determine eligibility for both narrative review and meta-analysis.

If the document is eligible for narrative review, the button next to “eligible for narrative review” will be highlighted.

If the document is eligible for meta-analytic review, the button next to “eligible for meta-analytic review” will be highlighted.
Crop Targeting Intervention

Tick the box for yes. Is this document reporting on a crop targeting intervention? A crop targeting intervention involves crop targeting as a drug control initiative that explicitly either exclusively, or in part, aims to manage, control, or reduce the wholesale supply of illicit drugs. Such interventions could include eradication, alternative development, substitution, monitoring, mechanical destruction, burning, or chemical or biological destruction. If the document is merely describing the way things are, and does not report on any specific action that is different, it is not eligible. If the document is talking about change in general terms, or suggesting an intervention, but is not actually reporting on a specific intervention that has actually taken place, it is not eligible.

Plant-based illicit drugs

Tick the box for yes. The drugs that will be considered in crop targeting interventions are all drugs that are illegally grown and cultivated according to international agreements and local (national) laws. Such illegal drugs include cannabis, coca, opiate and poppy straw. Studies that report crop targeting interventions with these drugs are eligible. The drugs must be plant-based, thus if the study focuses on any illicit drugs that are chemical based they are not eligible.

Descriptive review only

Tick the box for yes. The document must only describe an intervention, but provide no quantitative or qualitative evaluation of the intervention.

Process evaluation

Tick the box for yes. There must be a qualitative evaluation of the intervention; that is, they report on how successful the implementation of the intervention was, but do not actually provide any comparative outcome data.

Process evaluation with raw data

Tick the box for yes. The authors report on how successful the implementation of the intervention was, and provide raw data to support their conclusions, but do not actually provide a statistical analysis of the outcome data with sufficient data to calculate a standardised effect size. Examples of raw data include graphs or tables of outcomes per year, but with no calculations of differences before and after an intervention, or no correlations of outcomes with the intervention. Note: most data which is summarised separately for the control group and the intervention group could be considered an impact evaluation, even if an effect size has not been calculated. For further clarification, see the impact evaluation, below.

Impact evaluation

Tick the box for yes. There must be a quantitative evaluation of the impact of the intervention. This can include impact on local or global supply or consumption, impact on the environment or other factors included in the outcomes section. Do not include documents that say they are evaluations but are actually process evaluations; that is, they
report on how successful the implementation of the intervention was, but do not actually provide any comparative outcome data. Impact evaluations report statistics (eg. p values, r, d, g, t, F, Chi2) or report data summarised for the control and intervention groups, such as frequency tables, before and after means, and contingency tables.

Should you continue to code?

- Depending on the type of document, the form will enable certain fields
- Descriptive review documents require no more coding
- Process evaluation documents require no more coding; however, should there be insufficient impact evaluation documents, process evaluation documents will be coded in a second pass of coding, and qualitatively synthesised.
- Impact evaluation documents can be coded for studies and outcomes

Study info overview

These questions provide information about the document that will help us to determine whether the features of the study impact the outcomes of interventions.

Study name

If the document contains an eligible study, enter a “Study name”. This will automatically generate a new record for the study. If the study is not named in the document, invent an appropriate name eg “Author year study 1”.

Coded by

Select your name from the drop down list

Date coded

Click in this field for today's date

Study info tab

Country of intervention

Write the name of the country in which the intervention was implemented (note: do not confuse with the country in which the study was published; they may be different, e.g. a DFID study implemented in Congo but published in the United Kingdom).

Language

Write the name of the language of publication when we first retrieved it (i.e. some documents will have been sent to the translators – if you are reading the English translation but the original document was in Spanish, put Spanish).
Research timeframe

Write the years in which the study was running. If in doubt, the document should include information on what year the intervention was first implemented; write that in.

Intervention info tab

These questions provide information about the intervention that will help us determine whether the features of the interventions impact their outcomes.

Intervention name

Many intervention strategies have a name, e.g. “Plan Colombia”. Write in the name of the intervention, including detail to differentiate various interventions funded under the same model, if required. For example, Plan Colombia funded several conceptually distinct interventions – note “Plan Colombia” but provide further detail. If you can’t find an intervention name, write “none”.

Intervention strategy

Most crop targeting interventions fall under a broad definition of some kind of strategy, e.g. eradication, alternative development, substitution, monitoring. Eradication can involve mechanical destruction, burning, or chemical or biological destruction etc, and can be implemented manually or aerially. Try to identify a broad definition for this intervention. If the authors have identified what type of strategy it is, use their terms.

Full description

Write a full description of the intervention strategy (ideally limited to two or three sentences). Where possible, use the exact words used to describe the intervention in the text.

Comparison group

Describe what happened to the group / area that did not receive the intervention. If there is no information in the document about what usually happens in the absence of the intervention, write “no information”.

Law enforcement component

Write what law enforcement components were involved in implementing the intervention eg local police, border security, judiciary, military.

Who led the intervention?

Write in who implemented the actual crop targeting intervention.

Other components

Write what other actors were involved in the intervention. Use broad terms, e.g. health system, education system, government, NGO, volunteers, etc.
Funded by

Write what agency is funding the intervention. Use broad terms, e.g. federal government, local government, NGO, foreign government aid program (Foreign government here refers to the government of a country other than the country in which the intervention was actually implemented. For example, the United Kingdom’s Department for International Development funding police training in Nigeria would count as a foreign government aid program).

Evaluated by

Write what agency was responsible for evaluating the program. Use broad terms, e.g. local university, foreign university, local government, foreign government aid program, NGO.

Unit of treatment assignment

Write individual, geographic area, group, or other. This question is asking at what level the treatment was assigned; e.g. if some areas received the intervention but others didn’t, write geographic area. Write the specific geographic area, e.g. town, city, beat, neighbourhood, etc.

Unit of analysis

Write individual, geographic area, group, or other. This question is asking at what level the data were collected. For example, a survey of farmers would be at the individual level, local community police statistics would be at the community level, city crime rates would be at the city level.

Implementation success

These questions are intended to capture information about whether the intervention was implemented as intended.

Problems with implementation?

Tick box for yes. Did the authors mention any problems with the implementation of the intervention, e.g. funding didn’t reach the right people, activities were not carried out, changes in project staff caused delays, etc.; if so, put yes.

Problems with agency partnerships?

Put yes if the authors say that the agencies who were supposed to contribute did contribute everything they had agreed to; put no if the authors mention any problems with the partnerships; put unclear if nothing is mentioned; put not applicable (n/a) if the intervention was implemented by only one agency.

Issues in implementation

Write in what, if any, problems the authors identified in implementing the intervention. If none, put “none".
Quality

These questions are asking about the quality of the evaluation studies.

Monitoring of treatment delivery

Tick the box for yes. Does the paper identify any strategies for monitoring how the intervention was delivered (making sure that all areas that were supposed to receive the intervention received the intervention)? If the paper includes some figures on how the intervention money was spent, or on the activities undertaken by people working in the program, this counts as monitoring of treatment delivery and you should put yes.

Intent to treat analysis

Tick the box for yes. In the analysis, were the groups separated by how they were assigned (intent to treat – put yes) or whether or not they actually received the treatment (put no)?

Sample bias

Put yes, no or unclear. Was the sample selected randomly? If so, put no. Was the sample selected on the basis of the dependent variable (e.g. high crime areas selected for a drug reduction intervention)? If so, put yes. If the sample was selected by convenience (e.g. because the area had the resources to fund the intervention), put “unclear”.

Randomised

Tick the box for yes. Were areas allocated to treatment and control at random?

Type of comparison group

Describe the comparison group, e.g. randomly selected controls, matched controls, pre-test.

Serious limitations in research standards?

Tick the box for yes. If there are no obvious serious issues with the study, leave blank.

Specify limitations in research standards

Write in the problem. This is a catch-all question for any serious failings in intervention or evaluation design that are not captured by the other quality questions. If the study is clearly affected by some kind of bias not captured in the other questions, write what the bias is. Examples are: pre post test without a comparison group (stop coding if this is the case), statistical tests that don’t match the data collected, outcomes that are measured but not reported, participants are systematically different in treatment and control groups, other events systematically co-occurring with the treatment that could have affected the outcome, outcomes are measured differently in treatment and control groups, etc. Bias need not be methodological, but can also come from conflict of interest, which should also be noted here if identified.
Author’s conclusions tab

Authors’ conclusions

Write the authors’ overall conclusions for this study.

How did authors arrive at conclusions?

Describe in general terms the strategy that the authors used to arrive at their conclusions – was the study experimental, observational, a systematic review, an opinion piece etc? This is particularly important for process evaluations or general review articles.

Decision to code Outcomes tab

If the study does not provide comparative outcome data, you should stop coding now. If the document contains another study, click the “Add another study” button at the bottom of the form. If there are no further studies to code, click the right arrow button at the top of the form to bring up the next document.

If the study does provide comparative outcome data, you should continue to code the Outcomes tab.

Outcomes

This section is about the particular outcomes reported in the study. Only report outcomes that are evaluated. Fill out this section for every outcome and put each outcome on a new row.

Outcome

Put the general outcome category, e.g. consumption, production, cultivation, yield, net farm income, market availability and number of eradicated hectares etc. Remember, we are also including outcome measures relating to harm reduction and demand reduction, as well as undesirable or unwanted effects. Unwanted outcomes can include environmental damage, change in violent crime, displacement etc.

Conceptual definition

Write in the definition used by the authors. If the authors don’t provide a definition, write in whatever they’ve called the outcome.

Operational definition

Write in exactly how the outcome was measured; is it a count, sum, average, etc.; if it’s officially recorded information e.g. crime, what was the source, and in what timeframe; if it’s a survey measure, write in the exact wording of the items; and any other information on the measurement.
Data sources
Write official data, self-report, observations, etc. (more than one may apply): where did the data come from?

Authors’ conclusions
Write in what the authors concluded about the impact of the intervention on this outcome. Use their exact words where possible. Fill out this section for every outcome.

Was a standardised effect size reported?
Select yes or no. A standardised effect size is a value which is comparable across studies and not a function of the sample size (unlike, for example, a $t$, Chi$^2$ or $F$ statistic). Standardised effect sizes include: standardised mean difference ($g$ or $d$), odds ratio (OR), risk ratio (RR), correlation coefficient ($r$).

Effect size page number
Enter the page number on which the effect size is found. Please note: use the page number of the original document, not the page number of the pdf.

Effect size measure
Write in the type of effect size calculated eg. standardised mean difference ($g$ or $d$), odds ratio (OR), risk ratio (RR), correlation coefficient ($r$).

Effect size
Write in the value of the standardised effect size reported

Are data available to calculate an effect size?
Yes or no. An effect size can be calculated from mean and standard deviations, $t$ or $F$ value, Chi$^2$, frequencies or proportions, pre and post etc. If no, we will need to contact the author/s to request missing information.

Data to calculate effect size
Write in all of the statistics reported for this outcome. If the effect size estimates for this outcome are particularly complex (eg a regression table), place a note in this field to direct us to the correct page of the document (eg “See regression table 2 on page 37”). Please note: use the page number of the original document, not the page number of the pdf. This data will be entered into Comprehensive Meta Analysis to calculate a standardised effect size.

Outcome coded by
Select your name from the drop down list
Date outcome coded

Click in this field for today's date

Another outcome?

If the study contains another outcome, click the "Add another outcome" button at the bottom of the tab.

If there are no further outcomes to code, are there any more studies in the document? If yes, click the "Add another study" button at the bottom of the form. If no, click the right arrow button at the top of the form to bring up the next document.
### APPENDIX B: LIST OF STUDIES INCLUDED IN META-ANALYSIS

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<thead>
<tr>
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