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# The Costs and Benefits of Agricultural Crime Prevention

*A Primer for Estimating the Costs and Benefits of the Agricultural Crime Technology Information and Operations Network (ACTION)*


Aaron Chalfin, The Urban Institute
John Roman, The Urban Institute
Daniel P. Mears, Florida State University
Michelle L. Scott, The Urban Institute



URBAN INSTITUTE
Justice Policy Center

*Florida State University College of Criminology and Criminal Justice*


*research for safer communities*

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## Introduction

Offenders and potential offenders modify their criminal behavior in response both to changes in their risk of detection and capture and to the expected severity of punishment. Crime prevention programs seek to reduce crime either by reducing the benefits from offending or by increasing the costs of offending by raising the likelihood of detection. The Agricultural Crime Technology Information and Operations Network (ACTION) is a crime prevention initiative that applies both strategies through intensive policing and prosecution, surveillance equipment, information dissemination, and marking of equipment, supplies, and livestock to reduce agricultural crime in California's Central Valley. The key question for policymakers interested in crime prevention initiatives such as ACTION is whether the costs of the program are offset by the gains (benefits) from any crime reductions that result.

Crime in the agricultural sector is significant, totaling an estimated five billion in annual losses (Swanson et al. 2002:628). Agricultural crimes include theft of livestock, crops, equipment, chemicals, and pesticides, as well as vandalism and other forms of property crime (Mears et al. 2007). Costs of crime are passed along to consumers in the form of higher prices or are absorbed by farmers in the form of lower profits. Despite the magnitude of crime in this sector, agricultural crime has received very little attention from criminologists and criminal justice policymakers (Barclay 2001; Weisheit and Donnermeyer 2000).

This policy brief provides an introduction to cost-benefit analysis (CBA) as a means of measuring the effectiveness of ACTION and other such initiatives. The first section describes how CBA—a methodology that compares the costs and benefits of policies and programs to assess their economic efficiency—can be used to measure the economic impact of agricultural

crime prevention initiatives. Next, the challenges and opportunities particular to using CBA to evaluate crime prevention programs are developed. The final section describes the cost-benefit analysis of ACTION.

## Project Overview

At the time the study began, in 2003, ACTION included eight participating counties from the San Joaquin Valley. Since then, five more have joined. The thirteen program counties include: Fresno, Kern, Kings, Madera, Merced, Monterey, San Benito, San Joaquin, San Luis Obispo, Santa Barbara, Santa Cruz, Stanislaus, and Tulare. San Luis Obispo, the ninth participating county, joined ACTION in 2004, followed by Monterey in 2005, and San Benito, Santa Barbara, and Santa Cruz in 2006. Here, we focus on the ten counties that were participating as of 2005—the original eight, San Luis Obispo, and Monterey.[1] Together, these counties have a population of nearly 4.5 million people and contain 30,974 farms on 22,653 square miles of farmland. The ten counties are rural, and farmland covers about two-thirds of the geographic area. Most farms are relatively small, covering 0.73 square miles on average. As a result of the predominance of farming, these counties are relatively sparsely populated. Table 1 presents detailed demographic data on the ten counties.

[1] Monterrey County is not included the CBA analyses because it joined ACTION after data collection—specifically, a surveys of farmers—was complete. The survey data provide the foundation for the CBA.

**Table 1.** Demographic Information on the ACTION Implementation Area

| County | Population | Area (sq. miles) | Farm Area (sq. miles) | % of acreage | # of farms | Size of Average Farm (sq. miles) |
|---|---|---|---|---|---|---|
| Fresno | 866,772 | 5,963 | 2,940 | 49.3% | 6,952 | 0.42 |
| Kern | 734,846 | 8,141 | 4,453 | 54.7% | 1,997 | 2.23 |
| Kings | 142,561 | 1,391 | 1,028 | 73.9% | 1,079 | 0.95 |
| Madera | 138,952 | 2,136 | 1,002 | 46.9% | 1,673 | 0.60 |
| Merced | 237,005 | 1,929 | 1,377 | 71.4% | 2,831 | 0.49 |
| Monterey | 414,629 | 3,322 | 2,412 | 72.6% | 1,209 | 1.99 |
| San Joaquin | 649,868 | 1,399 | 1,263 | 90.3% | 3,862 | 0.33 |
| San Luis Obispo | 254,566 | 3,304 | 2,035 | 61.6% | 1,916 | 1.06 |
| Stanislaus | 498,355 | 1,494 | 1,144 | 76.6% | 4,009 | 0.29 |
| Tulare | 401,502 | 4,824 | 2,045 | 42.4% | 5,446 | 0.38 |
| **TOTAL** | **4,339,056** | **33,903** | **22,653** | **66.8%** | **30,974** | **0.73** |

Source: California Department of Finance (2002).

According to the California Department of Agriculture, with 88,000 farms and ranches, California agriculture is a $32 billion dollar industry that generates $100 billion in related economic activity. The agricultural output of the ACTION counties, among the most fertile in California (Table 2), have a combined value of $17.8 billion and constitute approximately 15% of all agricultural output in the United States (CIA 2005). Among these counties, there is approximately $800,000 in output per square mile of land used for agriculture.

**Table 2.** Agricultural Output of the ACTION Implementation Area

| County | Value of output | Output per Sq. Mile | Output Per Farm |
|---|---|---|---|
| Fresno | $3,418,600,000 | $1,162,884 | $491,744 |
| Kern | $2,208,500,000 | $495,944 | $1,105,909 |
| Kings | $885,100,000 | $861,035 | $820,297 |
| Madera | $748,200,000 | $746,868 | $447,221 |
| Merced | $1,538,500,000 | $1,117,036 | $543,448 |
| Monterey | $2,923,300,000 | $1,212,096 | $2,417,949 |
| San Joaquin | $1,348,700,000 | $1,067,603 | $349,223 |
| San Luis Obispo | $487,700,000 | $239,625 | $254,541 |
| Stanislaus | $1,197,300,000 | $1,046,221 | $298,653 |
| Tulare | $3,066,500,000 | $1,499,235 | $563,074 |
| TOTAL | $17,822,400,000 | $786,740 | $575,399 |

Source: CIA (2005).

Crime rates and number of police in the ten ACTION counties in 2003 are reported in Table 3. Overall, while the value of goods stolen in the counties is large ($101 million), the theft rate of 2.7 thefts per 100 residents is about 20% lower than the national average of 3.5 per 100.[2] Counties with higher populations have higher crime rates and also have more law enforcement officers. Theft rates are not directly related to the size of the county.

[2] Urban Institute analysis of survey data from farmers residing in nine ACTION counties.

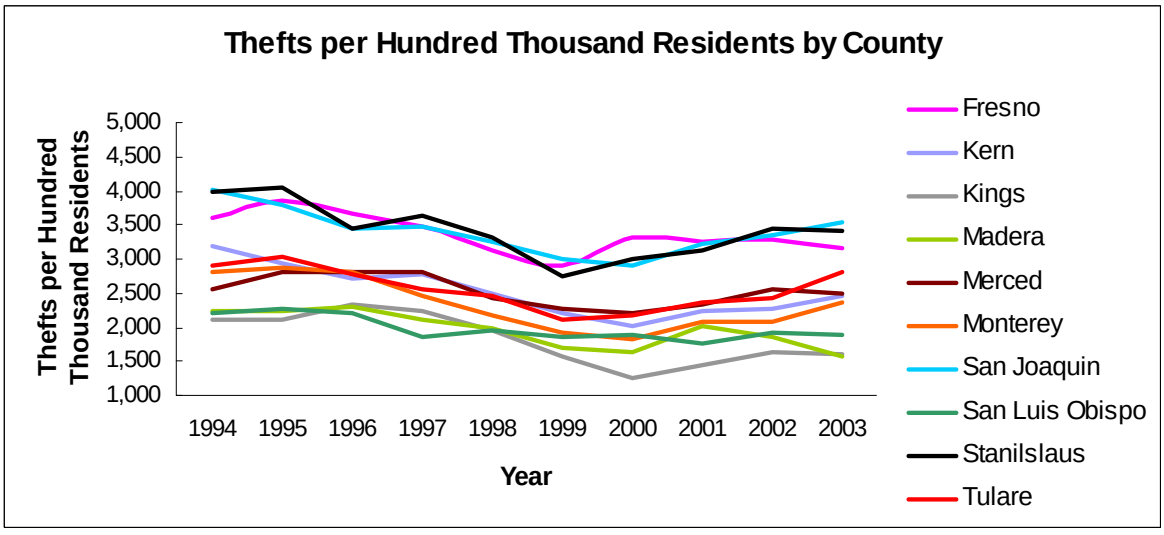
**Table 3.** Crime and Policing

| County | Population | Sq. Miles | Theft-Arrests | Thefts (2003) | Theft Per 100,000 | Law enforcement (sworn) | Law enforcement (total) |
|---|---|---|---|---|---|---|---|
| Fresno | 866,772 | 5,963 | 1,226 | 26,932 | 3,107.2 | 1452 | 2,541 |
| Kern | 734,846 | 8,141 | 1,536 | 17,743 | 2,414.5 | 935 | 1,704 |
| Kings | 142,561 | 1,391 | 199 | 2,239 | 1,570.6 | 163 | 315 |
| Madera | 138,952 | 2,136 | 135 | 2,090 | 1,504.1 | 145 | 203 |
| Merced | 237,005 | 1,929 | 545 | 5,780 | 2,438.8 | 355 | 488 |
| Monterey | 414,629 | 3,322 | 530 | 9,854 | 2,376.6 | 722 | 953 |
| San Joaquin | 649,868 | 1,399 | 1,642 | 22,140 | 3,406.8 | 927 | 1,668 |
| San Luis Obispo | 254,566 | 3,304 | 249 | 4,879 | 1,916.6 | 511 | ,847 |
| Stanislaus | 498,355 | 1,494 | 1,088 | 16,641 | 3,339.2 | 654 | 1,247 |
| Tulare | 401,502 | 4,824 | 704 | 10,999 | 2,739.5 | 717 | 1,006 |
| **TOTAL** | **4,339,056** | **33,903** | **7,854** | **119,297** | **24,814** | **6,581** | **10,125** |

Source: California Office of the Attorney General (2006).

As shown in the figure below, rates of theft generally declined throughout the 1990s, before rising slowly in the first three years after 2000.

**Figure 1.** Thefts by County




Source: California Office of the Attorney General (2006).

The origins of ACTION lie with a rural crime prevention demonstration project developed by the Tulare County District Attorney in 1995. In 1999, the California Legislature provided $3.5 million to Tulare and seven other counties for what was called the Rural Crime Prevention Program (RCPP) (Mears et al. 2007). This effort entailed the creation of a regional task force comprised of county agricultural commissioners, district attorneys, county sheriffs, and interested property owner groups, and led to the creation of a system for reporting and recording agricultural crime (Mears et al. 2007). In 2002, the program expanded in scope, with additional funds being used to hire personnel, purchase surveillance and marking equipment, develop an agricultural crime database, promote aggressive prosecution of agricultural crime, and educate farmers and law enforcement about such crime and how to combat it. Collectively, these activities comprise the ACTION program, which is integrated with and extends the RCPP efforts.

ACTION builds upon opportunity theory, the idea that crime can be reduced by limiting the opportunities that potential offenders have to offend. It also builds on the theory of the rational criminal (Becker 1968) in presuming that crimes are deterred when the probability of apprehension and conviction rises. To this end, ACTION has sought to increase awareness of agricultural crime among farmers in an effort to stimulate greater private spending on crime prevention while simultaneously devoting greater public resources to preventing agricultural crime and apprehending and prosecuting offenders.

The primacy of economic incentives in the theoretical foundation of the ACTION model supports the use of economic analysis as an important means in determining the effectiveness of the ACTION program. Before describing the economic evaluation of the ACTION

program, it is informative to describe a cost-benefit model that could be used in the study of ACTION or any similar crime prevention initiative. The sections that follow develop a CBA framework, describing each step in the model formulation. For a complete discussion of the impact evaluation of ACTION, please consult the final report (Mears et al. 2007).

## An Introduction to Cost-benefit Analysis

### WHAT IS COST-BENEFIT ANALYSIS?

CBA is an empirical approach designed to measure the economic impact of government intervention into private markets. Rather than a specific set of procedures, it is a "broad general approach" (Rothenberg 1975:55) used to quantify "in monetary terms the value of all policy consequences to all members of society" (Boardman et al. 2001:2). CBA contributes to policy formation through the comparison of policies and programs using a common metric. CBA is routinely used to inform a variety of public and regulatory policies, including environmental and land use regulations, job training programs, healthcare policy, and welfare policy (Boardman et al. 2001).

CBA has an advantage over other statistical methods in that the results can be used to compare two or more different programs that are designed to yield different kinds of outcomes (Gramlich 1981). It also can be used to determine which programming configuration yields the most efficient outcomes—such as identifying the most cost-effective use of limited resources within a program—or to select the most efficient approach among different policy options. CBA is able to measure changes resulting from new polices and programs to determine not only how the resources used affect participant outcomes, but also how those outcomes affect resource usage (Roman 2004). Finally, unlike other research

methods, such as regression analysis, CBA is able to estimate externalities that result from policy or programmatic changes that affect populations who are not direct participants in a policy or program (Gramlich 1981).

The application of CBA to the study of crime is a relatively recent phenomenon. Traditional economic CBA approaches used in other fields—health, transportation, labor—typically consider all of the changes in behavior resulting from a new policy or regulation in the context of a market framework. The application of CBA to the study of crime is not as straightforward, since private markets for the exchange of goods and services related to crime and crime prevention are limited. Many of the costs and benefits of crime are therefore difficult to translate into dollars. Criminal justice policies and programs may also affect the welfare of local communities in countless interdependent ways. The ripples in the community either from new crimes or from reductions in offending extend well beyond those few individuals directly affected. Determining the scope of an evaluation of the costs and benefits of crime control programs presents significant challenges that may be more limited in other policy areas with more discrete, easily measurable outcomes.

## THE CBA METHODOLOGY

Data are often costly to obtain and analyze, and a thorough CBA can be both expensive and resource intensive. Yet, CBA is a vitally important decision-making tool. Law enforcement resources are finite and only a small percentage of programs can be funded. Ultimately, it is more efficient to fund programs that produce the greatest return for each dollar spent rather than simply selecting those programs that have a large effect. In addition, because program impacts are not limited to those who participate in a program but also can

affect the welfare of a larger community, it is critical to include all such effects as well. CBA addresses these issues, utilizing a common unit of measure (usually a unit of currency) to monetize the costs and benefits of a policy or program, allowing policymakers to better assess the social value of a policy as compared to available alternatives. Questions to be answered in the development of a cost-benefit model will include:

- From whose perspective should costs and benefits be counted?
- Which enumeration strategy analysis (accounting, fiscal, economic) will be selected?
- How should social costs and benefits be counted?
- What will be counted as a cost and what will be counted as a benefit?
- What period of time will be studied?

The following section describes the impact of these decisions, and is followed by a discussion of data availability and analytic approaches. The report then describes our economic analysis of ACTION and details how we addressed the above questions in our analysis.

#### From whose perspective should costs and benefits be counted?

In assessing the costs and benefits of an agricultural crime prevention initiative, or any crime prevention program, it is prudent to begin by clearly specifying the policy questions that the CBA seeks to answer. This step brings focus to the analysis and makes subsequent decisions considerably easier (Lawrence and Mears 2004:7). Generally, the primary question is "Who do we think will benefit from the proposed policy (both directly and indirectly), and, who will pay the costs?" This question is answered by determining the perspective for the analysis—that is, who is to be included and excluded from the analysis. Typically, one of three perspectives are selected:

- A program- or agency-level analysis. This approach limits consideration of a program's economic impact to agencies most directly affected, which is usually the agency that administers the program. It is often used by an agency seeking to understand how a particular program will affect its balance sheet. Costs and benefits to participants, other agencies, and third parties that are only indirectly impacted are excluded from analysis. By extension, benefits from participant outcomes often are excluded (e.g., improving wages of a participant would only indirectly affect a labor agency through a share of increased tax receipts). This approach tends to undercount both costs and benefits.
- A system-level analysis. This perspective counts costs and benefits to all affiliated public agencies (e.g., all criminal justice system agencies), in what is sometimes called a public payer perspective. Indirect costs and benefits accruing to other agencies (such as health care or child welfare) are not included. As with the program/agency-level analysis, participant benefits are excluded, except for indirect increases in tax revenues. Since costs of policies and programs tend to be centered in one system, this approach tends to only slightly undercount costs. However, it also tends to substantially undercount benefits.
- A society-level analysis. This analysis counts costs and benefits to everyone in the state, region, or country (any of the three perspectives can be adopted) regardless of whether they are direct or indirect recipients of the program. This approach fully accounts for costs and benefits, but it also is the most expensive and complicated approach to adopt.

Of the three approaches, the society-level approach is considered the gold-standard, though the program- or agency-level analysis may be more relevant to a particular program or agency. Under the society-level approach, all costs and benefits are counted, and therefore the results are unbiased in the sense of not favoring certain costs or benefits over others. By contrast, the other approaches tend to undercount costs and benefits, and to undercount them inconsistently. However, the costs for conducting society-level analyses are high—to capture costs and benefits that ripple out from a new program, data must be gathered across a wide range of outcomes, and it frequently may be too costly or simply not possible to gather such data. Most researchers resolve this problem by focusing on areas that are expected to have the

highest costs and benefits. For example, most crime studies focus on benefits related to offending and health, since those tend to have the largest monetized outcomes.

In addition, an important class of costs and benefits that are excluded from all but the society-level analysis are called externalities. Economists define externalities as costs and benefits that are conferred upon an individual or agency without their consent. Externalities are important to measure because the welfare of a particular individual or agency can be substantially affected by the actions of a third party. For example, suppose a program delivers substance abuse treatment to drug-involved offenders who receive community supervision rather than incarceration. If the program is successful, it might reduce the number of crime victims. However, the costs of victimization are not paid for by a public agency, or the criminal justice system; rather, they are paid for by private citizens. As a result, if the number of crimes is reduced, private citizens benefit but public agencies do not. As such, a CBA that assesses the program's economic effect on the criminal justice system may understate the true benefits of the program to society. Example 1 (below) expands on this concept.

| **Example 1:** Program or Agency vs. System-Level Analysis |
| --- |
| Suppose that a county-level law enforcement agency is considering implementing a new program to install surveillance cameras in areas that have attracted a disproportionate amount of agricultural crime. Suppose, too, that the state has provided a grant to a county agency to facilitate installation of the cameras. From the agency perspective, this grant is "free" money since it did not come out of a county budget. The agency-level CBA of the surveillance program will not include the state grant as a cost of the program. However, the grant money was used in the program and excluding those costs underestimates the program's true costs. If another county were to implement the same program without the benefit of a state grant, it is likely to find the program to be more costly than expected. |

**Which enumeration strategy analysis (accounting, fiscal, economic) will be selected?**

The second question concerns how costs and benefits are measured. One approach is relatively straightforward—examine how much was directly spent (costs) and how much was directly saved (benefits) by looking at actual program accruals and outlays. This approach follows what is generally called an *accounting* strategy. Although intuitive, the approach has several limitations. First, the actual expenditures in any jurisdiction are likely to be useful only to that jurisdiction—other places face different prices for similar personnel and capital goods. Second, agencies often receive discounts on goods and services that they use, whereas another agency may be part or all of the costs. Therefore, it is difficult to generalize from these costs, since they are specific to one agency at one point in time. Finally, as is described in the next section, this strategy for counting costs, according to whether money was saved or expended, is likely to lead to biased estimates of costs and benefits.

Similar to the accounting strategy, a *fiscal* cost analysis focuses on the effect of a program on the budget of a single agency or budgetary unit. It is often the case that a CBA will be commissioned by an agency seeking to understand how a particular program will influence its financial balance sheet. Since the agency is concerned only with the program's effect on its own costs and benefits, costs to other agencies or benefits to third parties that are not directly relevant to the agency's decision-making process may be excluded from the analysis.

An *economic* strategy for cost analysis includes not only all accounting costs but also opportunity costs as well. An opportunity cost is the true value of a good as measured by its next best use. For example, if a new program is given space to use for free, the opportunity cost would be the value of that space had it been rented. Even if an agency did not have to pay

for a particular service component, the cost of this component would be included in an economic CBA. The intuition behind this approach is that it describes the true costs of the program, and therefore will reflect the costs faced by others seeking to replicate the program. Therefore this approach produces results that can easily be generalized to other jurisdictions.

#### How should social costs be counted?

One challenge unique to CBA of crime programs is the issue of how gains to offenders are treated. For property crimes in particular, a strong argument can be made that there is no real loss of value resulting from the crimes. If no loss of value occurs when a crime is committed, it is unclear what to count as the benefit of preventing the crime. Suppose $1,000 worth of avocados are stolen. In this case, ownership is transferred from victim to offender, but the value of the avocados remains the same, and thus, it could be argued that society does not experience a loss. (Clearly, the original owner of the avocados experiences a loss.) One approach, the *social welfare approach*, adopts this concept and considers only changes in the value of resources. A second approach, the *external cost approach*, explicitly excludes gains to offenders on the grounds that they lack standing since they have violated the social compact. That is, it only counts the loss to the victim and not the gain to the offender. Although most cost-benefit analyses use the external cost approach, a discussion of the differences reinforces other important CBA constructs.

The concept of *social cost* has been used by policy analysts to assess the impact of legal and regulatory interventions since the 19th century. Social costs are the total change in welfare of all members of society as a result of some sort of activity. In some contexts, using the social costs of an activity to compute costs and benefits is sensible, particularly if no illegal activity

occurs. For example, suppose a new law reduces the speed limit. To the extent that drivers obey the law, the reductions in speed-related auto accidents creates a benefit to society in the form of reductions in health expenditures, missed work, etc. However, travel times will increase, which creates a cost to society. If instead the reduction in speed is due to increased enforcement of existing laws, the same benefits will occur (fewer accidents) but the costs would be excluded from an external cost CBA, since those costs (increased travel time) are costs to law-breakers and not to the rest of society.

#### What will be counted as a cost and what will be counted as a benefit?

The next step in the conceptual development of a CBA is the creation of a typology of costs and benefits where each activity is designated as a cost or a benefit. A CBA that is careless in assignment of costs and benefits to mutually exclusive categories can create substantial bias in outcomes, especially in benefit-cost ratios. There are two potential sources of confusion in assignment. First, in a CBA of crime, many of the benefits of effective programs arise from a stakeholder not having to spend resources on an unwanted activity. It is intuitive in those cases to state that "costs" were saved. Although technically correct, this nomenclature—calling benefits averted costs—can create confusion. To avoid this confusion, it is valuable to discretely label some activities as costs and some as benefits.

One common, but inappropriate approach, is to label all new spending as costs and all new savings as benefits. Another common, but inappropriate approach, is to label every transaction in one period as costs and transactions in another period as benefits. The problem with these approaches is that they confound causal inference. New spending that occurs in a later period would be counted in both approaches as a cost. But, for example, suppose that the

ACTION program led farmers to receive new information about their risk of victimization, and to increase their spending on private crime prevention as a result. In fact, that change in spending is caused by the program, and the CBA should capture that causal relationship.

A more appropriate way to classify costs and benefits is to count program activities as costs and all resulting outcomes as benefits. For example, as applied to ACTION, a CBA analysis might count program activity (more police officers, surveillance equipment, etc.) as costs and various outcomes (lower crime rate, lower costs per victimization, changes in spending on crime prevention, etc.) as benefits.

#### Which costs should be included in a cost-benefit analysis?

The final step in the development of the CBA is to identify the specific activities that should be counted as a cost, which entails an understanding of program impact. However, determining which outcomes occurred because of a program and which outcomes would have occurred in the absence of a program can be challenging. *In general, costs associated with a program should be included if and only if they occur as a result of the program under study*. For example, suppose an intervention like ACTION increases a farmer's knowledge of effective crime prevention strategies. Further, suppose that farmer then purchases and installs locks on his sheds, and each night brings all tools from the field to the shed and locks them there. In this example, the farmer's investment in equipment and time are the direct result of the program and are therefore costs. However, if the farmer had already brought all tools from the field to the shed each night—but had not previously locked the shed, only the cost of the locks and their installation should be included as a cost of the program.

**Types of costs—fixed, average, marginal?**

There are three types of costs that are relevant in a CBA. Each of these cost types will influence the outcome of the CBA in different ways. For this reason it is important to divide all relevant costs into each of the following types:

- A fixed cost is one "that remains constant, in total, regardless of changes in the level of activity within the relevant range" (Garrison and Noreen 2000:58). A fixed cost is paid at the initial stages of a program and does not depend on the number of individuals the program serves or the size of the program generally. For example, a fixed cost might include the purchase of a building in which a program's headquarters and administrative offices are located. The cost of the office is paid up front by the program's funders, and, assuming that the office is sufficiently large, the office's cost will not vary as the program takes on greater responsibilities or expands its time horizon.
- A marginal cost is the cost of an additional unit of some good or activity. Each new lock a farmer purchases to secure a single piece of equipment is a new marginal cost.
- An average cost is the total cost divided by the number of units.

Selecting which approach to use, and the relative importance of that decision, depends on the type of program under analysis. For example, consider the installation of a surveillance system. The installation of a central monitoring station is a *fixed cost*—the costs are the same regardless of how many surveillance cameras are wired to the station. In addition, there is a new (*marginal*) cost to each additional camera purchased. The question is, Which is a better measure of the costs of the surveillance camera system: the *average* cost or the *marginal* cost? In the example above, the *average* cost would suffice—each additional camera has identical costs. Now consider the costs of the farmer's time spent monitoring those cameras, which we assume, for the sake of argument, to be $30 per hour. If the farmer monitors three cameras, the average cost approach would estimate the cost of his or her time at $10 per hour per camera. However, in reality, the farmer can monitor three cameras as easily as one, so there is

no new cost imposed on the farmer by monitoring additional cameras. The marginal cost perspective would value the cost of monitoring the first camera at $30 per hour and the cost of monitoring the second and third at $0 per hour. If the CBA is attempting to measure the most efficient use of resources—for example, how many cameras should be purchased—the average cost approach is appropriate for valuing the cameras and the marginal cost approach is more appropriate for valuing the farmer's time.

#### Which benefits should be counted in a cost-benefit analysis?

Having considered costs, we now turn to measuring benefits—that is, what are the outcomes caused by an intervention? The benefits of a crime prevention program may accrue in one of two ways. First, the program might result in fewer crimes and fewer victimizations because some would-be offenders are deterred or some actual offenders are caught. Second, the initiative might change private expenditures on crime prevention, with positive benefits if the program in turn is able to reduce spending on crime prevention and safety.

In general, as with costs, benefits should be counted if and only if they would not have occurred but for the intervention. In some cases, benefits may have accrued to parties during the course of the intervention's implementation period that would have arisen for reasons not directly related to the intervention. Typically, statistical procedures are used to isolate the impact of the crime prevention program from confounding factors on each array of benefits.

#### Benefits from abated crime?

While measuring costs is often a straightforward exercise, measuring the benefits of a crime prevention program is often much more difficult for two reasons. First, unlike programs in other fields designed to create new resources (such as a new road that saves

commuters time or a training program that leads to new or better jobs for participants), anti-crime programs create benefits when less of a bad thing occurs. Put differently, positive benefits are derived from avoiding harms. It is often difficult to measure such effects since it requires that the observed reality be compared to a hypothetical (e.g., What level of crime would have resulted in the absence of the program?).

Second, benefits from crime programs are difficult to measure since the losses from crime may result in effects that are not directly observable. Consider the theft of tools. While the value of the stolen tools can be directly measured, the farmer may face additional costs in absorbing their loss. For example, some investment of time is required to order new tools. In addition, the loss of the tools may upset the farmer, who might be angry at the theft or fearful of additional theft. Whenever possible, CBA analysts want to account for the indirect costs of crime when monetizing the benefits of abated criminal activity.

There are three primary methodologies that economists use to assess the value of goods when prices are not directly observable (hereafter referred to as "non-market goods"), as is the case for many of the outcomes of interest: contingent valuation, hedonic pricing, and avoided cost. Each of these methodologies has a number of advantages and disadvantages. The general approaches, and strengths and limitations of each, are described below.

### Avoided Cost Method

The most common empirical strategy—"the avoided cost method"—estimates the benefits of a policy or program in terms of the costs that are not incurred due to a successful program. As noted above, it is common for anti-crime programs to generate outcomes that mainly avoid future harms rather than creating new tangible goods. In this approach, the value of a

non-market good can be inferred from its components or from closely related goods. For instance, the value of preventing an agricultural crime, such as theft of tools, would be measured as the total value associated with all the components of being a victim: direct cost to replace tools, missed work, aggravation, and fear.

The advantage of the avoided cost methodology is that little additional data is required beyond the data needed for a program evaluation. All behavioral changes resulting from the program, such as changes in crime rates, will be identified in the course of a typical program evaluation. The role of the CBA analyst is limited to assigning prices to behaviors (such as the costs to the victim of a theft of tools) and linking those prices to evaluation data. The disadvantage of the avoided cost method is that the accuracy of the valuation depends directly on the strength of the proxy. For example, the farmer may attend counseling session(s) to address his anger with being victimized, and an avoided cost approach would use the cost of those sessions to estimate the "aggravation" component of the cost of victimization. The cost of counseling may not, however, completely capture the costs to the farmer. In practice, finding a strong proxy is often as difficult as measuring the non-market good.

The two alternative approaches described below (contingent valuation and hedonic pricing) can be used as either substitutes or complements to the avoided costs approach. That is, they can be used instead of the avoided cost approach (which is generally how hedonic pricing is applied) and as a means of developing estimates for hard-to-value prices. For instance, instead of using the cost of counseling sessions in the example above, many researchers use contingent valuation data on the intangible costs of victimization (pain, suffering, aggravation, and fear) as part of the avoided cost estimates.

Contingent Valuation

Contingent valuation is a survey-based valuation technique used to value goods that are not bought and sold in the free market, and for which prices (values) are therefore hard to compute (such as the pain and suffering from being victimized). Often used to determine the value of an environmental resource such as a national park, it also has broad applicability to assessing the effect of crime on community well-being. Typically, contingent valuation survey questions ask individuals how much money they would be *willing to pay* for an increase in some non-market good (such as safety), or, conversely, how much money they would need to be fully compensated for a decrease in the quantity of a non-market good. For example, a farmer might be asked how much money he or she would be willing to pay to avoid the theft of tools. Responses from a sample of farmers can be averaged to develop an estimate of hard-to-observe costs.

Naturally, the use of contingent valuation is not without controversy. Economists worry that contingent valuation surveys are especially prone to four main sources of bias. First, respondents may engage in strategic behavior, intentionally inflating their answers in an attempt to gain favor for a policy they support. Second, respondents may ignore their own income constraints when devising a value for a resource and price a good beyond what they could reasonably afford. Third, since stated preferences are hypothetical, responses may be arbitrary since the respondent does not actually need to pay the stated price. Fourth, the approach heavily discounts the responses of those with little or no wealth since they may highly value a good but have no means of paying for that good. In addition, contingent valuation suffers from the bias that can result from using survey data—for example, low

response rates may lead the analyst to generalize from a non-random sample, which, in turn, may bias estimates.

Hedonic Regression (Pricing)

Hedonic regression is an econometric technique used to estimate the value of a non-market good by valuing and summing up the value of each component part. Applying this approach to crime policy, differences in the value of similar farms in different areas could be used to estimate the cost of agricultural crime to farmers. In a regression framework, one would use regression coefficients to estimate the marginal willingness of farmers, on average, to pay for an additional unit of neighborhood safety.

The advantage of using hedonic pricing to value non-market goods is that the model draws inferences about what people really do rather than what they think they might do, which is the basis for contingent valuation. Hedonic prices use actual consumer behavior in the market place to develop estimates, which avoids many of the biases introduced by contingent valuation. However, there are disadvantages to using hedonic pricing methods. First, hedonic pricing models reflect what consumers believe to be true, which may differ from reality. For instance, if farmers believe that neighborhood A is safer than neighborhood B when in reality the opposite is true, the hedonic pricing estimates will reflect this misconception. In addition, the approach requires sophisticated econometric modeling, which may increase the cost of conducting CBA.

**What period of time will be studied?**

To implement the approach described above, a discrete time period for evaluation must be selected. The time period should have three characteristics: first, as much as possible, it

should capture the entire period when costs and benefits occur; second, it should be consistent for both costs and benefits; and, third, it should include only those time periods when activities can be causally linked to the evaluation. The first characteristic is the most critical and is discussed in greater depth below. The import of consistency is clear: if the costs and benefits are not measured over the same period, then it is possible that some costs or benefits will be excluded, biasing the analysis. The third characteristic is one that is usually addressed in a program evaluation that informs the cost-benefit, but is worth mention here. If a program changes behavior, the effect on behavior may not persist in perpetuity. Therefore, it is appropriate to include only outcomes that can be directly linked to the program. For example, if ACTION reduces crime in the year following its implementation, it can not be assumed that those benefits continue to accrue in following years. (Conversely, some impacts may take years to emerge but once they do they may remain relatively stable thereafter.)

Returning to the issue of what period to study, since costs and benefits may accrue at a nonlinear rate, an unbiased CBA will include the entire period when costs and benefits occur. For example, many of the costs of ACTION occur as up-front costs, such as the purchase of expensive surveillance equipment. Benefits, however, would be expected to occur over a longer time period and may even increase with time as the program evolves and stabilizes. As a result, comparing the costs and benefits only in the early period may yield a biased estimate as the program will not have had sufficient time to recoup high fixed costs.

#### Discounting future events?

If a multi-year assessment period is appropriate, it is critical that the cost-benefit framework accounts for the time-value of money. Economists have long recognized that most

people value one dollar received today more than one dollar received sometime in the future. The idea that the value of money decreases with time is not due simply to individual preferences. In fact, there is a very real opportunity cost to receiving the money in the future—money received today could be invested, increasing the amount available in the future. For example, if a risk-free investment (such as a treasury note) yields a real interest rate of 5%, $10,000 received today would be worth $12,763 in inflation-adjusted terms in five years. Therefore, for some other investment (with risk) to be chosen instead of treasury notes, that investment must return more than $2,763. An important feature of the time-value of money principle is that it can be used to determine what the true value of money received in the future is in today's dollars. In the example below, the typical individual will be indifferent between receiving $10,000 today and $12,763 in five years.

The same logic applies to valuing costs and benefits of programs that occur in the future. The process described above of converting future dollars into present-day values is known as discounting. Failure to account for such effects may lead to inappropriate conclusions. For instance, if a $10,000 investment in an agricultural crime initiative is estimated to yield an $11,000 benefit that occurs in five years, the real value of those benefits is less than $10,000 in today's dollars, and therefore the investment would not be cost-effective.

Appropriately discounting future costs and benefits is important in any assessment of the costs and benefits of crime prevention initiatives. For example, suppose a policymaker is tasked with selecting between two agricultural crime prevention initiatives, described below.

| **Example 2:** Discounting the Benefits of an Agricultural Crime Program | | | | | |
|---|---|---|---|---|---|
| **Program** | **Costs** | **Benefits** | **Period** | **Benefit-Cost Ratio** | **Benefit-Cost Ratio (Net Present Value)** |
| 1 | $10,000 | $15,000 | 1 year | 1.50 | 1.43 |
| 2 | $10,000 | $18,000 | 7 years | 1.80 | 1.28 |

* Net present value assumes a 5% real annual return on investment

At first glance, Program 2 appears to be a better investment, since the benefits are larger and the benefit to cost ratio (BCR) is higher. However, since the benefits accruing from Program 2 do not accrue for seven years, the benefits are only worth $2,800 in today's dollars, compared to the $4,250 for Program 1. After adjusting for the time-value of money, it turns out that Program 1 is a more cost-effective investment.

### CHANGES IN PRIVATE EXPENDITURE AS A BENEFIT

So far, this brief has mainly considered the public costs of a crime prevention initiative. That is, the amount of crime is taken as a given, and it is assumed that society will determine how much to invest in policing, courts, corrections, and other crime prevention efforts to off-set the harms caused by crime. This investment is known in the literature as the social welfare function and provides a mechanism to determine what society considers to be the appropriate level of investment in criminal justice. The approaches described above describe various strategies designed to estimate the costs to victims to be used in these investment calculations.

*However, it is also likely that changes in public investment in crime prevention will affect individual decisions about how much crime prevention to purchase*. This influence is particularly likely when the crime prevention efforts are used to protect goods and services at risk of theft. Since the value of the goods likely to be stolen typically are known to their owner, that

owner can make an informed decision about how much time and money should be spent protecting that good. If, for instance, police patrols are increased, an owner might reasonably conclude that the police are providing a subsidy. Since the police are providing more protection, he or she can undertake less crime prevention while still enjoying a comparable level of protection. Conversely, the owner might reasonably conclude that his or her goods are at a greater risk of being stolen, believing that the police have stepped up patrols in response to more crime. The influence of the police on the owner's understanding of crime-risk can be termed an informational effect. In such a scenario, the owner might choose to increase his or her crime prevention efforts. A CBA can be used to measure which of these effects is larger and which allows for more accurate measures of the real costs of the program.

One of the primary goals of crime prevention programs such as ACTION is to stimulate private spending on crime prevention by increasing farmers' awareness of agricultural crime. The additional information is expected to lead the farmer to conclude that he or she is spending too little on crime. Another key objective is to increase surveillance of farms. As in the example above, the effect of that increased surveillance on the farmer's behavior is ambiguous—it may cause the farmer to provide more or less private security. Notably, although the effect of the program on private spending can not be known before the program starts, it has a direct impact both on the cost of the program and on the program's outcomes.

Differentiating these two competing effects is crucial to determining the benefits of an agricultural crime prevention program. If the *subsidy* effect of ACTION is larger than the *informational* effect, the installation of surveillance equipment by law enforcement may cause farmers to reduce their own crime prevention expenditure and vigilance, perhaps

substantially. If the informational effect is larger, then private spending is likely to increase. Either way, it is possible that a change in private behavior may occur, which could have a considerable impact on the ratio of benefits to costs of ACTION.

## The Limitations of Cost-Benefit Analysis

The following section discusses potential sources of error and uncertainty in CBA and offers strategies for dealing with the limitations of cost-benefit analyses.

### SPECIFIC LIMITATIONS

#### Data are incomplete or potentially biased

The data needed for CBAs are often incomplete and costly to collect. Administrative data from public agencies are the cheapest source of data, but they are often collected for purposes other than research. As a result, administrative data often must be supplemented by other data, either proxy data from another source or primary data collection, such as surveys of individuals. If data can be found that are a close proxy for missing data or survey responses are accurate and free from systematic bias, the validity of a CBA may be unaffected by data issues. However, in practice, finding fully accurate and reliable proxies for missing data is difficult.

#### Benefits may be unobserved and difficult to value

While direct benefits (e.g., preventing the loss of tools) are the most obvious and likely the most significant source of benefits associated with agricultural crime, they are not the only potential benefit. Each criminal act also imposes a set of intangible costs on a farmer. Developing estimates of the value of those intangible harms requires either that a number of assumptions about farmers' attitudes towards victimization be made or that farmers be

surveyed directly, thereby introducing potential bias into the estimate. Therefore, in the absence of market data—and there is no market for intangible harms—establishing proxies for the value of stolen or damaged goods may involve a degree of uncertainty. Since different means of estimating damages will likely lead to differential monetization of the benefits, both the analyst conducting the CBA and the policymaker relying on the CBA should be aware of any implications arising from a preference for one method of estimation over another.

## ADDRESSING THE LIMITATIONS OF COST-BENEFIT ANALYSIS

The accuracy of a CBA will always be directly proportional to the accuracy of the underlying data. There is no quick fix for the methodological problems that underlie all CBAs. However, the analyst does have a critical tool at his disposal—sensitivity analysis—to assess the degree of uncertainty underlying a CBA and endow the policymaker with the ability to test the sensitivity of the results to changes in baseline assumptions. First, as in the example below, it can be used to construct a confidence interval for the cost-benefit estimate.

**Example 3:** Sensitivity Analysis

Suppose that administrative data only provide average estimates of the costs of a crime prevention program. However, after interviewing stakeholders, researchers find that there is significant variation in costs across program sites. The chart below details different assumptions about the costs and benefits of an agricultural crime prevention program. For simplicity, only a few categories of costs and benefits are considered.

| **Cost Domain** | **Minimum Estimate** | **Average Estimate** | **Maximum Estimate** |
|---|---|---|---|
| Labor cost | $5,000 | $7,800 | $8,500 |
| Equipment | $3,200 | $3,800 | $4,000 |
| Overhead | $1,200 | $1,500 | $1,700 |
| **Benefits Domain** | **Minimum Estimate** | **Average Estimate** | **Maximum Estimate** |
| Crimes prevented | 16 | 20 | 26 |
| Reduction in cost per victimization | $800 | $1,000 | $1,200 |

Using both the least and most generous assumptions about the costs and benefits of the program described above, the analyst can construct a confidence interval that provides the policymaker with the range of possible benefit-cost ratios (BCRs). As shown in the table below, this CBA is quite sensitive to the assumptions used to generate cost estimates. If the least generous assumptions are made, the program is found not to be cost-beneficial (BCR < 1). However, if the mean or average assumptions are used, the programs returns $1.53 on every dollar invested. Unless the policymaker has reason to believe that the least generous assumptions are more likely to reflect the true costs of the program, the weight of the evidence suggests that the program is cost-beneficial.

**Example 4:** Sensitivity Analysis (continued)

| Assumption Set | Cost | Benefit | Net Benefit | BCR |
|---|---|---|---|---|
| Least generous assumptions | $14,200 | $12,800 | ($1,400) | 0.90 |
| Average assumptions | $13,100 | $20,000 | $6,900 | 1.53 |
| Most generous assumptions | $9,400 | $31,200 | $21,800 | 3.31 |

Sensitivity analysis can also be used to determine which elements create the greatest uncertainty. In the example below, benefit-cost ratios are constructed for each cost category first for the lowest (minimum) estimates, then again for the largest (maximum) estimates. A range of the largest to smallest BCRs can then be created. The larger the BCR range, the more sensitive the variable estimates are to the underlying assumptions. In this example, the CBA is more sensitive to the number of victimizations abated (range between minimum and maximum BCR = 0.76) than to labor cost (range = 0.59).

| **Example 5:** Sensitivity Analysis (continued) | | | |
|---|---|---|---|
| **Type** | **BCR (minimum)** | **BCR (maximum)** | **Range** |
| Labor cost | 1.56 | 2.15 | 0.59 |
| Crime prevented | 1.22 | 1.98 | 0.76 |

GENERAL LIMITATIONS

One other criticism of CBA is worth noting, one which can not be resolved through sensitivity analysis. It is often noted by critics of the approach that CBA does not usually account for issues of equity or fairness. For example, a community might prefer that an anti-crime program maximize benefits to small farmers because small farmers have much smaller margins and are at a greater risk of bankruptcy from theft than operators of large farms. It is possible to attach weights to the outcomes to adjust for the relative importance of different program beneficiaries. However, because this introduces another layer of assumptions into the CBA, such an approach may exacerbate rather than alleviate criticisms of findings.

## Using Cost-Benefit Analysis to Evaluate ACTION

We now apply the principles of CBA to evaluate ACTION. In evaluating ACTION, we use a social welfare perspective, taking into account costs to all relevant parties, including public agencies, taxpayers, and crime victims (farmers). Consistent with our decision to exclude the welfare of offenders from the analysis, we used an external cost approach. We focus here on a one-year implementation period (2004-2005). Administrative cost data were obtained from the relevant district attorney's offices in each of the ACTION counties. Self-reported data on private expenditure on crime prevention and victimization were derived from responses to a survey distributed to farmers in 2005 in nine counties.

COSTS

ACTION has required the hiring of a new personnel whose time is fully or partially dedicated to preventing agricultural crime. For example, a regional coordinator was hired to facilitate communication between the ACTION counties and staff were hired to undertake a variety of activities, including the purchase and installation of alarms and surveillance cameras and marking of farmers' equipment. Table 4 contains a full account of the administrative costs of the ACTION program. The total expenditure of $2,000,000 on the ACTION program yields an influx of public crime prevention and information into the community of $65 per farm. Table 5 divides costs of the program into fixed and variable components.

**Table 4.** Administrative Costs of ACTION

| **Program Input** | **Cost** |
|---|---|
| Personnel | $650,109 |
| Wages/Salaries | $527,342 |
| Fringe Benefits | $122,767 |
| Travel | $72,251 |
| Equipment | $409,997 |
| Wireless surveillance cameras (5) | $43,000 |
| Wireless surveillance camera upgrades (5) | $13,525 |
| Large microwave transmitter system (1) | $27,000 |
| Wireless alarm systems (6) | $23,400 |
| Video surveillance systems (2) | $16,430 |
| GPS tracking units (2) | $22,470 |
| Wide format graphics printer (1) | $12,133 |
| Color laser jet printer (1) | $7,811 |
| Photo quality scanner (1) | $1,428 |
| Forensic computer servers (2) | $21,800 |
| Full-size pickup trucks (5) | $125,000 |
| Supplies | $437,139 |
| Consultants/Contracts | $116,348 |
| Other Administrative Expenses | $303,480 |
| Indirect Costs | $20,676 |
| **TOTAL** | **$2,000,000** |

Source: California Office of the Attorney General (2006).

| **Table 5.** Fixed and Variable Costs of ACTION | | |
|---|---|---|
| **Cost Category** | **Fixed Cost** | **Variable Cost** |
| Personnel | | $650,109 |
| Travel | | $72,251 |
| Equipment | $409,997 | |
| Supplies | $437,139 | |
| Consultants/Contracts | | $116,438 |
| Other Administrative Expenses | | $303480 |
| Indirect Costs | $20,676 | |
| **TOTAL** | **$847,136** | **$1,162,954** |
| Source: Urban Institute analysis of ACTION cost data. | | |

## BENEFITS

The benefits of ACTION accrue in one of two ways. First, ACTION might directly prevent crime either by capturing and incapacitating offenders or by deterring potential offenders. Second, by increasing the amount of information available to farmers, the initiative might indirectly reduce crime by changing private expenditure on crime prevention. The latter benefit will be positive if farmers reduce their expenditure on crime prevention and negative if they increase their expenditure on crime prevention.

Our CBA of ACTION relies on farmers' self-reported victimization and crime prevention behavior from 2004-2005. Table 6 describes the change in the number of victimizations. Driven by a rise in thefts of tools, equipment, fuel, and chemicals, victimizations per farm rose from 2.76 to 3.21 over the course of the study period. This represents an increase of about 16% in the number of crimes and about 9% in the likelihood of any crime. In particular, theft of tools, fuel and chemicals, and vandalism all increased. Table 7 summarizes changes in the cost of victimization. Corresponding victimization losses

rose from $2,001 in 2004 to $3,338 in 2005, an increase in $1,338 per farm.[3] This represents about a 67% increase in the costs of victimization.

**Table 6**. Number of Victimizations Per Farm by Type of Victimization

| Category | 2004 | 2005 | Change | p-value |
|---|---|---|---|---|
| Tools or small equipment | 0.88 | 1.00 | 0.12 | 0.01*** |
| Tractors | 0.06 | 0.07 | 0.01 | 0.65 |
| Large (non-tractor) equipment | 0.10 | 0.09 | -0.01 | 0.41 |
| Livestock or poultry | 0.26 | 0.18 | -0.08 | 0.67 |
| Fuel or chemicals | 0.43 | 0.56 | 0.13 | 0.00*** |
| Fruit, vegetables, grain, feed and seed | 0.41 | 0.44 | 0.03 | 0.52 |
| Burglary | 0.28 | 0.32 | 0.05 | 0.22 |
| Vandalism | 1.00 | 1.09 | 0.09 | 0.05** |
| **Total** | 2.76 | 3.21 | 0.45 | 0.01*** |
| **Any Crime** | 0.32 | 0.35 | 0.02 | 0.23 |

Source: Urban Institute Analysis of ACTION Survey Data

* significant at a = 0.10, ** significant at a = 0.05, *** significant at a = 0.01 level

**Table 7**. Cost of Victimizations Per Farm by Type of Victimization

| Category | 2004 | 2005 | Change | p-value |
|---|---|---|---|---|
| Tools or small equipment | $745 | $1,003 | $258 | 0.08* |
| Tractors | $344 | $585 | $241 | 0.44 |
| Large (non-tractor) equipment | $333 | $353 | $20 | 0.90 |
| Livestock or poultry | $129 | $677 | $548 | 0.25 |
| Fuel or chemicals | $470 | $573 | $103 | 0.61 |
| Fruit, vegetables, grain, feed and seed | $166 | $114 | -$52 | 0.50 |
| Burglary | $285 | $377 | $92 | 0.40 |
| Vandalism | $201 | $323 | $122 | 0.16 |
| **Total** | $2,001 | $3,338 | $1,338 | 0.12 |

Source: Urban Institute Analysis of ACTION Survey Data

* significant at a = 0.10, ** significant at a = 0.05, *** significant at a = 0.01 level

Although aggregate reported crime increased between 2004 and 2005, it is not necessarily accurate to say that the increase in victimization losses observed over the study period has been the result of ACTION or that ACTION has not been successful in reducing damages

[3] Though the change in victimization losses is not significant at conventional levels, we can conclude with 88% confidence that the result holds.

accruing from agricultural crime. Such a finding may be spurious; that is, may result because other factors have not been accounted for in the simple analysis described in Tables 6 and 7. (Indeed, as the final report details, victimization is lower or has been reduced among farmers in areas where ACTION been more aggressively implemented—Mears et al. 2007.) For instance, it is reasonable to think that farmers may have changed not only their behavior with respect to crime prevention activities, but also their reporting activities. For instance, because of ACTION, farmers may have been more likely to notice and report theft. This idea is supported by the finding above that while the incidence (number) of crime and prevalence of crime (any crime) increased only modestly, 16% and 9% respectively, the value of those crimes increased substantially (67%). This difference could be accounted for by a dramatic change in the types of crime committed. However, the data in Table 7 suggest that the cost per crime rose in every category. This finding is more consistent with a change in reporting practices than in crime. (For a complete discussion of the impact evaluation of ACTION, which examined differential effects of the program based on variation in the level of program implementation in different counties and areas, please consult Mears et al. 2007.)

Table 8 describes changes in the private expenditure on crime prevention undertaken by farmers (e.g., the degree to which farmers changed their expenditure on crime prevention over the course of the study period). Expenditure on crime prevention includes purchases of such equipment as surveillance and alarm systems as well as spending on insurance from theft and the farmer's time spent on crime prevention activities. For the 2004-2005 time period, farmers increased their total expenditure on crime prevention by $715 per farm, or about 12%.

**Table 8**. Private expenditure on crime prevention

| Category | 2004 | 2005 | Change | p-value |
|---|---|---|---|---|
| Surveillance equipment | $139 | $236 | $98 | 0.08* |
| Alarm systems | $280 | $298 | $18 | 0.56 |
| Locks | $105 | $159 | $54 | 0.12 |
| Fences | $749 | $983 | $234 | 0.06* |
| Other | $431 | $638 | $208 | 0.14 |
| Insurance costs | $4,392 | $4,492 | $100 | 0.43 |
| Value of farmer's time | $108 | $112 | $4 | 0.18 |
| Total | $4,532 | $5,387 | $855 | 0.02** |

Source: Urban Institute Analysis of ACTION Survey Data

* significant at a = 0.10, ** significant at a = 0.05, *** significant at a = 0.01 level

The statistics in Table 8 support the idea that farmers substantially changed their behavior in response to ACTION. The change in reported private anti-crime expenditures (16%) is similar to the self-reported change in criminal incidence (16%) and prevalence (9%). If an empirical analysis demonstrated that the dominant effect of ACTION was a change in access and use of information (over increased public anti-crime efforts) then it would be reasonable to believe that much of the reported change in the cost of victimization was due to reporting changes rather than increases in victimization.

We compared the impact of changes in information and changes in increased public enforcement to address this issue. Then, to test the impact of changes in information—the *information effect*—we measured the number of times a farmer reported having used agcrime.net, an online warehouse of information about protecting one's property from agricultural crime. To measure the impact of increased policing activity, we measured the quality of policing reported in 2004 and 2005, which we call the *subsidy effect*. If farmers' perception of the quality of policing increased, it is reasonable to believe that they would have reduced their own crime prevention spending, other things equal. That is, if the police are

better at preventing crime, in effect farmers receive a costless increase in crime prevention. Economic theory predicts that farmers will then reduce their own spending, resulting in similar levels of crime prevention at a lower cost to the farmer.

Using this model, we estimate that farmers increased their expenditure on crime prevention by $45 in response to increased information provided by ACTION, but reduced their expenditure on crime prevention by $12 in response to changes in the quality of policing associated with ACTION. Overall, we estimate that ACTION resulted in increased expenditure on crime prevention by $33 per farm. Although this amount may appear trivial, the results indicate that the true costs of the ACTION program are $98 per farm or about 50% higher than public costs alone (the program itself spent $65 per farm). As such, to achieve the minimum level of efficiency required to improve social welfare, ACTION would have to result in, at minimum, a $98 decrease in per-farm victimization losses.

## DISCUSSION

The findings above lend support to the theory that the information effect of ACTION dominated the subsidy effect. In practice, this means that farmers faced a choice once ACTION was implemented—they could costlessly reduce their own spending if the increase in policing was the most important impact of ACTION or they could increase their spending if the increased availability of information was the most important impact of ACTION. The data suggest that increased information was the biggest cause of change in farmers' behavior. The result of that increased information was a marked increase in spending on crime prevention. This finding supports, but does not prove, that changes in reported crime victimization were due to changes in reporting rather than real increases in crime.

## Conclusion

CBA is a useful tool that can assist policymakers with decision-making. Specifically, it allows them to systematically compare the costs and benefits of a number of alternative policies or programs. The steps and considerations presented in this brief are intended to guide policy analysts and policymakers both in conducting original cost-benefit inquiries and in assessing prior empirical work.

Like any analytical tool, CBA is not without its limitations. Missing or incomplete data and the difficulty involved in observing non-market transactions often reduce the reliability of cost-benefit assessments. To an extent, the analyst can mitigate these problems by finding reliable and creative ways to obtain proxies for missing data. When such proxies cannot be found, the analyst should do all he or she can to make the CBA as transparent as possible. Typically, transparency requires conducting a detailed sensitivity analysis of the results as well as presenting additional considerations that are important to fully understanding and appreciating the results of an analysis.

CBA, even in the absence of perfect data, can make a substantial and positive contribution to the policymaking process. Using CBA to evaluate existing and future agricultural crime prevention initiatives can aid in the process of developing a national agricultural crime reduction strategy that aims to reduce the impact of agricultural crime in our communities in the most efficient and cost-effective way possible.

## References

Barclay, Elaine. 2001. A Review of the Literature on Agricultural Crime. Armidale, New South Wales: Criminology Research Council.

Becker, Gary. 1968. "Crime and Punishment: An Economic Approach." Journal of Political Economy 76:169-217.

Boardman, Anthony, David Greenberg, Aidan Vining, and David Weimer. 2001. Cost-Benefit Analysis. Upper Saddle River, NJ: Prentice Hall.

California Department of Finance. 2002. California County Profiles. Sacramento, CA: California Department of Finance. Available on-line: http://www.dof.ca.gov/HTML/FS_DATA/profiles/profiles02.pdf.

California Office of the Attorney General. 2006. Statistics by City and County. Sacramento, CA: California Department of Finance. Available on-line: http://ag.ca.gov/cjsc/datatabs.htm.

Central Intelligence Agency. 2005. World Factbook. Washington, D.C.: CIA. Available on-line: https://www.cia.gov/cia/publications/factbook.

Gramlich, Edward M. 1981. Benefit-Cost Analysis of Government Programs. Upper Saddle River, NJ: Prentice Hall.

Lawrence, Sarah, and Daniel P. Mears. 2004. Benefit-Cost Analysis of Supermax Prisons: Critical Steps and Considerations. Washington, D.C.: The Urban Institute.

Mears, Daniel P., Michelle L. Scott, and Avinash S. Bhati. 2007. A Process and Impact Evaluation of the Agricultural Crime, Technology, Information, and Operations Network (ACTION) Program. Washington, D.C.: The Urban Institute.

Roman, John. 2004. "Can Cost-Benefit Analysis Answer Criminal Justice Policy Questions, And If So, How?" Journal of Contemporary Criminal Justice 20:257-275.

Rothenberg, J. 1975. "Cost-Benefit Analysis: A Methodological Exposition." Pp. 89-122 in Handbook of Evaluation Research, edited by Marcia Guttentag and Elmer Streuning. Beverly Hills, CA: Sage.

Swanson, Charles R., Neil C. Chamelin, and Leonard Territo. 2002. Criminal Investigation. Columbus, OH: McGraw-Hill.

Weisheit, Robert, and Joseph F. Donnermeyer. 2000. "Changes and Continuity in Crime in Rural America." Pp. 309-359 in The Nature of Crime. Washington, D.C.: National Institute on Justice.