How Can Economists Contribute to Mine Action?

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This article reviews the contribution economists can make in the area of humanitarian mine clearance and describes the development of a software package and manual designed to help managers decide which combination of machine and manual methods should be used to clear minefields to the required safety standard at the lowest cost.

by Dan Marsh | University of Waterloo |

Millions of emplaced mines in 62 countries cause over 15,000 civilian casualties per year, mostly in rural areas of developing countries. There is much international effort to obtain clearance only by making millions of hectares unavailable for crop production or livestock grazing. Their impact is primarily felt by the poor, who are most likely to be forced to enter mine-affected areas in search of firewood, drinking water or grazing for their livestock. Refugees are often unwilling to return home when their land has not been cleared of landmines, causing a long-term burden on host communities and aid agencies. The world has responded to this humanitarian imperative by emplacing landmines and unexploded ordnance by spending over $1.5 billion (U.S.) on mine and unexploded ordnance clearance since 1992, but little of this spending has been subject to rigorous economic analysis.

There are at least four areas of mine action in which economic analysis can assist decision-making. The first (and possibly most controversial) is whether mines should be cleared at all—to the point where the marginal cost per life saved is the same as the value of a statistical life. The second is the ranking of mines cleared. Which Areas Should be Cleared First? This involves a selection of priorities for mine action that are essential—little different from any other prioritisation exercise. The idea that limited funds should be concentrated on the areas with the greatest need is widely accepted. Methodologies are well-developed and, with appropriate modifications, can be applied to mine action.

The Geneva International Centre for Humanitarian Demining (GICHD) commissioned the Management Research Centre of the University of Warwick to develop a model to assist mine action managers with determining the cost-effectiveness of different methods of mine clearance. The study is vitally important that scarce mine action resources be deployed in such a way as to achieve the best possible outcomes. Cost-effectiveness analysis has a key role to play in achieving this.

Cost-effectiveness analysis can be approached in two ways:

1. By determining the least costly method of achieving a known goal—in this case, mine clearance to a level of at least 99 percent, or the fixed-effectiveness approach.
2. By finding the policy alternative that will provide the largest benefits for a given level of expenditure—the fixed-budget approach. CE MOD (fixed-effectiveness approach). CE MOD compares different methods of mine clearance. Analysis of alternative methods is generally more useful than comparing different machines in isolation, since each machine may make a different contribution to mine clearance. A cost-effectiveness exercise is defined as any combination of techniques (e.g., machines, manual clearance, dogs, etc.) that achieves the standard goal of at least 99-percent clearance. For example, a given piece of land might be cleared to the same standard by four different methods:

1. Manual mine clearance only
2. Flail followed by manual mine clearance
3. Vegetarian career followed by manual mine clearance
4. Flail followed by dog teams, supported by manual mine clearance

Data entry. When CE MOD is started, users are provided with the system menu (see Figure 1) and asked to enter data. The system will then turn the entered data into a format that can be used to find the most cost-effective mine clearance method. Users click on “Data Capture” if they want to enter new project data or want to edit values already entered in the model. The “Reports” button takes them to another menu where they can choose to view and print some (or all) of the standardized cost-effectiveness and prioritization results.

The cost-effectiveness model requires three types of data:

1. Information on the location and details of the project and on the type of analysis being conducted (e.g., cost vs. projected costs)
2. Information on area clearance rates and the time inputs (e.g., man-days for manual clearance and days of machine use), which might typically come from log books
3. Information on costs, which would typically come from project accounts and budgets or equipment catalogues

The “Database Menu” is used to access data entry screens for each of these three types of data (see Figure 2). In the “Area Cleared Data Entry Menu,” users are asked to attribute areas cleared and time inputs (man-days and machine-days) to each of the various methods that their agency has used (for analyses of past costs) or is considering using (for projections).

Figure 1: CE MOD system menu. Graphic courtesy of Dan Marsh/MAIC

Figure 2: CE MOD data-capture menu. Graphic courtesy of Dan Marsh/MAIC

Marsh: How Can Economists Contribute to Mine Action?
in the “Costs Data Entry Menu,” users are asked to enter data on the actual or projected costs of the mine clearance project. The costs in the model are grouped into four categories: staff salaries, staff allowances, consumables and running costs, and capital equipment. Within each of these cost categories, there is no restriction on how many cost items are specified. Thus, the model can handle analyses of both past costs, based on detailed budgets, as well as projected costs, for which there might be rather less detail available. For each cost item, the user is asked to specify a name or description for the item, the number of items used and the unit-cost per item per year.

For each cost item, the user is asked to allocate the number of units across various cost categories (e.g., management and administration, mine survey, medical support, manual mine clearance teams, dog teams and individual machines). This allocation of the number of units of each cost item allows the user to provide in “Mechanical Mine Action Study: Cost Effectiveness Component, Draft Final Report.”

**Model output and interpretation.** The reports menu is used to view and print the results of the model’s calculations, as well as print the worksheets that contain the input data on an area cleared, days used and costs by category.

The “Standard Reports” button lists the user view and print four reports (see Table 1).

**The “Key Results” report (Table 2) includes total cost, cost per square metre, cost ratio and annual cost saving. Based on the imaginary data in Table 2, use of a flail, followed by a mechanised mine clearance method. Costs per square metre (about 1.2 square yards) are $3.41 (U.S.) compared to $11.29 using manually methods (the base case). Use of this method over the whole area to be cleared would result in a cost saving of $7.2 million or 30%.

It must be stressed that cost per square metre should only be compared where all other factors are equal, i.e., for clearance of mined land of similar characteristics. Differences in cost per square metre between manual and mechanised methods (e.g., slope vs. flat, dry vs. wet) are likely to be relevant to the decisions agencies make about the most cost-effective way to clear a given area.

For example, an agency may use different machines to do a similar task (e.g., vegetation clearance) but on land with different characteristics. While it is possible to have a model that considers factors such as slope, it may not be possible to model the qualitative differences in clearance even though they are likely to be relevant to the decisions agencies make about the most cost-effective way to clear a given area.

A similar complication comes from the fact that mines are different. For example, a machine’s output is user-dependent because if the machine is being used, it would be more difficult to use the model for planning purposes. Instead, it is expected that the model will tend to divert funds away from other risk-reduction activities where more deaths and injuries could be avoided at lower cost.

**CEMOD was developed as a practical tool that would be used by managers to assess the cost-effectiveness of alternative mine clearance methods. Feedback received so far has been positive. Some other recommendations are that more attention be made to the use of CEMOD. Given the large sums of money involved, potential cost savings are substantial.**

**Conclusions**

Many of the key issues of mine action are amenable to cost-effectiveness analysis. In this respect, mine action is no different from any other activity that uses scarce resources. Policy in this field has often been strongly influenced by both military and humanitarian considerations and approaches. Mine action agencies have often seen mine clearance as being a technical problem requiring technical solutions. Too often, insufficient attention has been paid to cost-effectiveness in determining the best course of action. Humanitarian concerns have brought the impact of mines to the world’s attention. The Ottawa Convention, however, the Convention’s requirement that all mines be cleared will not always be the best way of improving the plight of those affected by mines. Likewise, the U.N. standard of 99.6-per-cent clearance will often be too stringent and will tend to divert funds away from other risk-reduction activities where more deaths and injuries could be avoided at lower cost.

Humanitarian Demining as a Precursor to Economic Development

Using three specific examples—Mozambique, Eritrea and Iraq—the author shows how clearing mines to restore power lines, rail service and agricultural land helps communities become economically viable again.

Further uptake of CEMOD may be achieved if appropriate follow-up activities are carried out. Some managers will require advice and support before being convinced of the benefits of cost-effectiveness analysis. There may also be areas where managers will require input from a trained economist (e.g., in some complex cost-allocation decisions). There is also scope to further develop the model based on feedback from the first version.

This article has demonstrated the importance of economic analysis if scarce funds are to be used efficiently to assist the development of mine-affected areas. The key questions to be addressed are:

- **Should mine-affected areas be cleared?**
- **What is the appropriate standard of clearance?**
- **Which areas should be cleared first?**
- **Which methods should be used?**
- **Better answers to these questions can only help the millions of people who live and work at risk of death or injury from mines and UXO.**

This paper describes work done for the GICHD as part of their Mechanical Mine Action Study that was carried out jointly with John Gibson, University of Canterbury and Gez-Bob Gibson and includes material from Marsh, Bob Gibson and Barns, et al.

See “References and Endnotes,” page 105.

Dan Marsh is a senior lecturer in economics at the University of Waikato in New Zealand. He has 25 years’ experience working on mine and demining development projects in Asia, the Middle East and Africa. He is a member of the GICHD and CEMOD expert groups.

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### Table 1: Cost-Effectiveness Model Output

<table>
<thead>
<tr>
<th>Cost Category</th>
<th>Total Cost</th>
<th>Cost per square metre</th>
<th>Cost Ratio vs Base Case</th>
<th>Annual Cost Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Only</td>
<td>1,128,742</td>
<td>11.27</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Flail &amp; Manual</td>
<td>1,156,574</td>
<td>5.78</td>
<td>51%</td>
<td>5,009,138</td>
</tr>
<tr>
<td>Flail, Manual, Dogs</td>
<td>1,365,574</td>
<td>3.41</td>
<td>30%</td>
<td>7,165,574</td>
</tr>
<tr>
<td>Veg. Cutter, Manual</td>
<td>365,602</td>
<td>7.31</td>
<td>65%</td>
<td>3,617,597</td>
</tr>
<tr>
<td>Area Reduction then Manual</td>
<td>304,352</td>
<td>6.07</td>
<td>54%</td>
<td>4,732,347</td>
</tr>
<tr>
<td>Veg. Cutter, Manual, Dogs</td>
<td>247,035</td>
<td>6.94</td>
<td>44%</td>
<td>5,774,610</td>
</tr>
<tr>
<td>Area Reduction, MP, Manual</td>
<td>587,267</td>
<td>13.75</td>
<td>104%</td>
<td>-416,703</td>
</tr>
</tbody>
</table>

### Table 2: Example of Key Results Report

**Cost per Square Metre and Potential Savings by Method and Area**

A comparison solely on the basis of cost per square metre will not reveal the full story. A hidden advantage of some machines may be that they clear to a greater depth than others. Likewise, the U.N. standard of 99.6% clearance will often be too stringent and will result in a cost saving, which would not be revealed by the signing of the Ottawa Convention. Hence, the Convention’s requirement that all mines be cleared will not always be the best way of improving the plight of those affected by mines. Likewise, the U.N. standard of 99.6% clearance will often be too stringent and will result in further cost savings away from other risk-reduction activities where more deaths and injuries could be avoided at lower cost.

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Endnotes

1. LIS is an abbreviation for Level One Survey that is commonly used in Cambodia. This is not to be confused with LIS (Landmine Impact Survey), which is in common use in most other parts of the world.

References


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