LIS Advisory 04:
Background Paper on Socio-Economic Indicators

Purpose

This background paper by Dr. Aldo Benini discusses the socio-economic indicators used in the LIS and explains and defends the 'compassionate measure' LIS approach to measuring mine impact.

Terminology

Mined area: the LIS term is 'suspected hazard areas'
Enumerator: the LIS term is 'interviewer'

Attachments

None

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The Global Landmine Survey and Socio-Economic Indicators

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Summary

Several Impact surveys – formerly known as Level-1 Surveys - are currently being undertaken within the Global Landmine Survey. The survey in Yemen was completed in summer 2000, and, at the same time, surveys were on-going in Chad, Mozambique, Thailand and Cambodia. In a format adapted to the emergency conditions, a modified impact survey was executed in Kosovo during the winter of 1999 / 2000.

As the body of survey findings and of methodological lessons grows, it is important to keep up the conceptual work. One of the essential objectives of the survey is to provide a ranking of communities by mine impact that can inform the allocation of mine action resources. Indicators are used, and are combined in an index – the impact score – to create the ranking. This paper restates the logic of the impact score.

The score relies on a “weak metric” approach. The use of qualitative information was adopted for the sake of survey reliability. The informational properties of the measurement have been investigated theoretically; they are being tested in practical scenario-building with a national mine action center. Results from the Yemen survey are presented in a perspective that relates accidents to conflict as well as community background variables. A computer simulation was run on the information value of the score; its findings are also included. The conceptual consequences for the survey are briefly touched upon in a situation like Kosovo, where remote data collection largely replaced interaction with members of local society.

Essentially, the impact score embodies a multi-dimensional and compassionate approach to mine action. The survey collects and processes information on affected communities, suspected hazard areas and on victims, and each of the three layers influences the score. Nevertheless, the score essentially is a property of the affected community, and the LIS remains focused on communities rather than mined areas or individuals.

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Introduction

During 1998 and in the first half of 1999, intensive preparations took place to get Impact survey operations started as part of the Global Landmine Survey. Since then, the Survey Action Center (SAC) and other concerned agencies have been doing empirical work in several countries. In Kosovo, SAC helped the UN Mine Action Coordination Center map affected communities geographically by combining information in the mine action database with that of other relief agencies (Messick 2000). In Yemen, the Afghan Mine Clearance Planning Agency (MCPA), with SAC and UNMAS assistance, completed a survey, identifying 592 contaminated communities.

Moreover, at the time of this writing (October 2000), surveys were being carried out by the Canadian International Demining Centre (CIDC) in Mozambique, by Handicap International (France) in Chad, by Norwegian People's Aid (NPA) in Thailand, and by the Canadian firm GeoSpatial International Inc. in Cambodia. In Lebanon, a survey may be started up in spring 2001, at first as an emergency survey for the South, and then, if required, an impact survey for the rest of the country. In Vietnam, a survey may take several years, starting in 2001.

Other countries may follow. In addition to the emergency and normal impact surveys, countries with long-standing mine action and survey traditions may demand novel modifications of the impact survey formats in order to allow them to retrofit useful existing databases. This is happening in Cambodia, and may well turn out to be a necessity in Angola and Afghanistan.

Hand in hand with the fieldwork of the first impact surveys, conceptual refinements, testing and practical tooling have taken place in those countries as well as for the upcoming surveys. This work is ongoing. IMSMA has seen its field module substantially revised. The standard design of the impact survey has not been immune to calls for change either. For example, several mine action NGOs prevailed to have elements of visually verifying mined areas included in the impact survey agenda. That addition, although complicating the work of the surveyors, was successfully argued as necessary by individuals with demining experience.

Other mine action professionals also have high expectations of the surveys and may want to see their conceptual focus and information needs expanded. Beyond the world of mine action, larger development issues and comparative returns on mine action vs. other investments may impact programme design, and calls for evaluation of mine action programmes may grow stronger.

Therefore, there is reason to believe that lively conceptual debates will spring up in future. At the same time, the MBT states-parties demonstrated unqualified enthusiasm for the LIS and SAC's approach when presented with the findings from Yemen. The LIS description of the landmine problem in terms of affected communities is being seen as a valuable contribution to the understanding of a worldwide problem. With limited resources for clearance, victim assistance, and awareness education, and with the simultaneous need to set defensible priorities, the ability to rank communities in terms of socio-economic impact is enormously powerful and helpful to the mine action community.

Successes in Kosovo and Yemen are likely to help maintain continued interest in the impact survey and the creation of related databases. However, high expectations and developments outside SAC are also liable to create added turbulence in the survey's conceptual and organizational environment, and thus the stability of key assumptions – such as a consensus on indicators -- may prove precarious.

To see why that is so, a minimum appreciation of the impact survey's complexity is required. The survey as such is not very complicated. At its core, the impact score is calculated for each individual community. The enumerators who survey affected communities routinely do this. Also, the survey products are intuitively appealing. For example, SAC's maps of the Kosovo situation were met with approval by the entire mine action community.

The same people who admire the graphic power of the maps may have greater difficulty to evaluate their validity and reliability. When scenarios are recalculated for hundreds of surveyed communities, it is harder to convince others of the potential and limits of the impact scores produced out of an arcane database algorithm. What should keep the interest in such conceptual questions alive is the fact that any socio-economic framework and indicator system will eventually need to pass tests similar to those which the Impact survey has set for itself. They will need to prove that they address relevant questions, that the indicators and their derivatives are valid, and that the protocols help to collect reliable data.

The Landmine Impact survey: Logic and Professional Interests

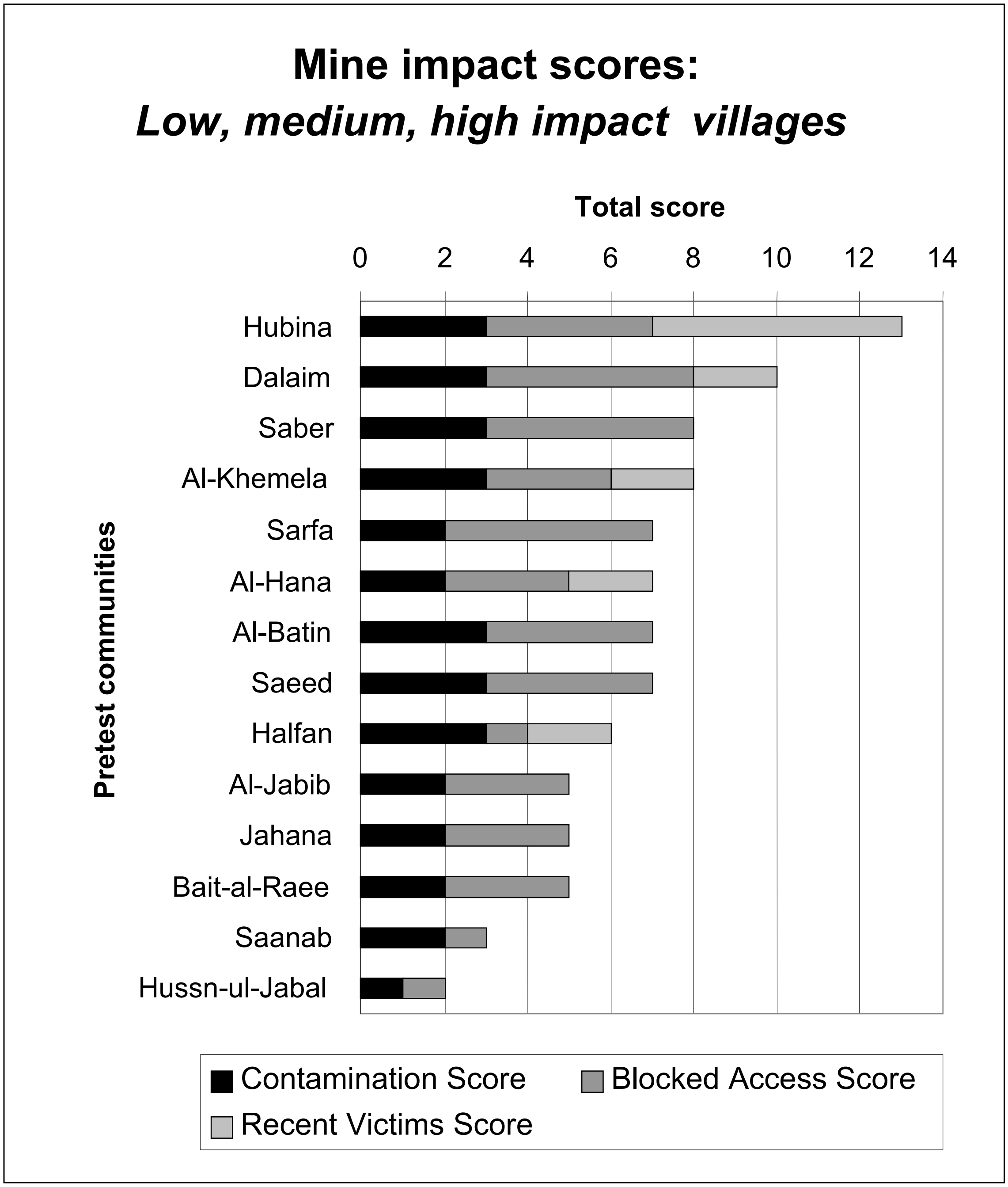
The Survey Working Group is committed to have,

> "within the next two years, the Global Landmine Survey .. produce high quality survey data on the socio-economic impact of landmines. This survey, conducted by visiting all the mine-affected communities within a country, will provide the foundation for a wide range of subsequent mine action activities." (GLS 1998:1).

This commitment requires the surveys to excel in two dimensions: the validity of its concepts, variables and outputs, and the reliability of the data:

• The survey products need to validly inform decision making by the mine action personnel that use them. The current design of the survey provides hope for acceptable content validity (Litwin 1995: 35) of key concepts and instruments, as seen through the eyes of "a set of reviewers who have some knowledge of the subject matter", such as the participants of the SAC Impact survey training symposia.

Diagram: Impact score composition, examples from Yemen



This bar diagram highlights one of the first empirical findings of the Impact survey. 14 of the 26 communities surveyed during the pretest in Yemen are shown with their respective impact scores. These communities reported a small number of recent victims, but claims to mine-induced blockages were frequent.

- The data used in those products must be reproducible by other observers and at different points of time, other things remaining equal. In practice, verification will remain the exception rather than the rule; therefore, the survey has to be conducted so that initially, the data is collected reliably.

The survey design has responded to those challenges with several innovations:

- In the social dimension, the community has been made the basic unit of analysis, away from the traditional focus on the mined area and on its physical properties.

- Substantively, the core activity is the construction and measurement of a composite mine impact index. The index – called the impact score -- is not a simple utility function, but a compassionate measure for past suffering and for the potential to reduce suffering.

- In the temporal dimension, the survey is staggered over several phases, formerly known as Level 1, 2 and 3 Surveys. These have become “Impact surveys”, “Technical Surveys”, and “Post-Clearance Documentation”, respectively. At each progressive level, the breadth of the survey should decrease, and its depth increase.

For the Impact survey, the scope is deliberately limited. Essentially, it records types of problems that the mines have created for a community. It does not go deeply into measuring the extent of those problems.

However, the purview of the impact survey may not satisfy all mine action professionals. In fact, because mine action is carried out, if not propelled, by professions with well-developed doctrines and strong networks. It is entirely foreseeable that pressure for the rationales, design and practice of the Impact surveys will change to follow the directions of those involved.

- The demining community, staffed largely by ex-military staff, will press for more technical data to be included, enriching the impact survey with elements of a technical survey. Their demands may go beyond the current provisions for size estimates and visual verification of mined areas. This behaviour is illustrated by the effort to draw mined area polygons during impact data collection in Thailand, prompted by the close cooperation between the foreign NGO and the national mine action centre: a military agency.

- The social and medical professions will be gratified by the improved ability to enter their information requirements for victim assistance easily into the

If they find systematic gaps, as they indeed exist such as on the victims of older date, they will want to see the formats changed to their needs.

- On the donors' side, the concern with the impact of the mine action projects that they finance will call for economic analyses, such as cost-benefit analyses, and thereby exert pressure for the adoption of stronger metrics. However, mine accident reduction will be difficult to accommodate in such frameworks since most agencies will shy away from putting a value on a human life.

The mine awareness community, as a newer field, may be filled with professionals from more diverse backgrounds, and as such may be conceptually more fluid and less likely to press specific demands on the Impact survey design.

The Impact score as a compassionate measure

The impact score is the central element of the survey design. While its basic function – to permit a priority ordering of communities – is easy to understand, its technicalities are not so easily understood. More importantly, the score is designed as a multi-dimensional measure to facilitate reports of a kind that help to keep enthusiasm and compassion for mine action burning.

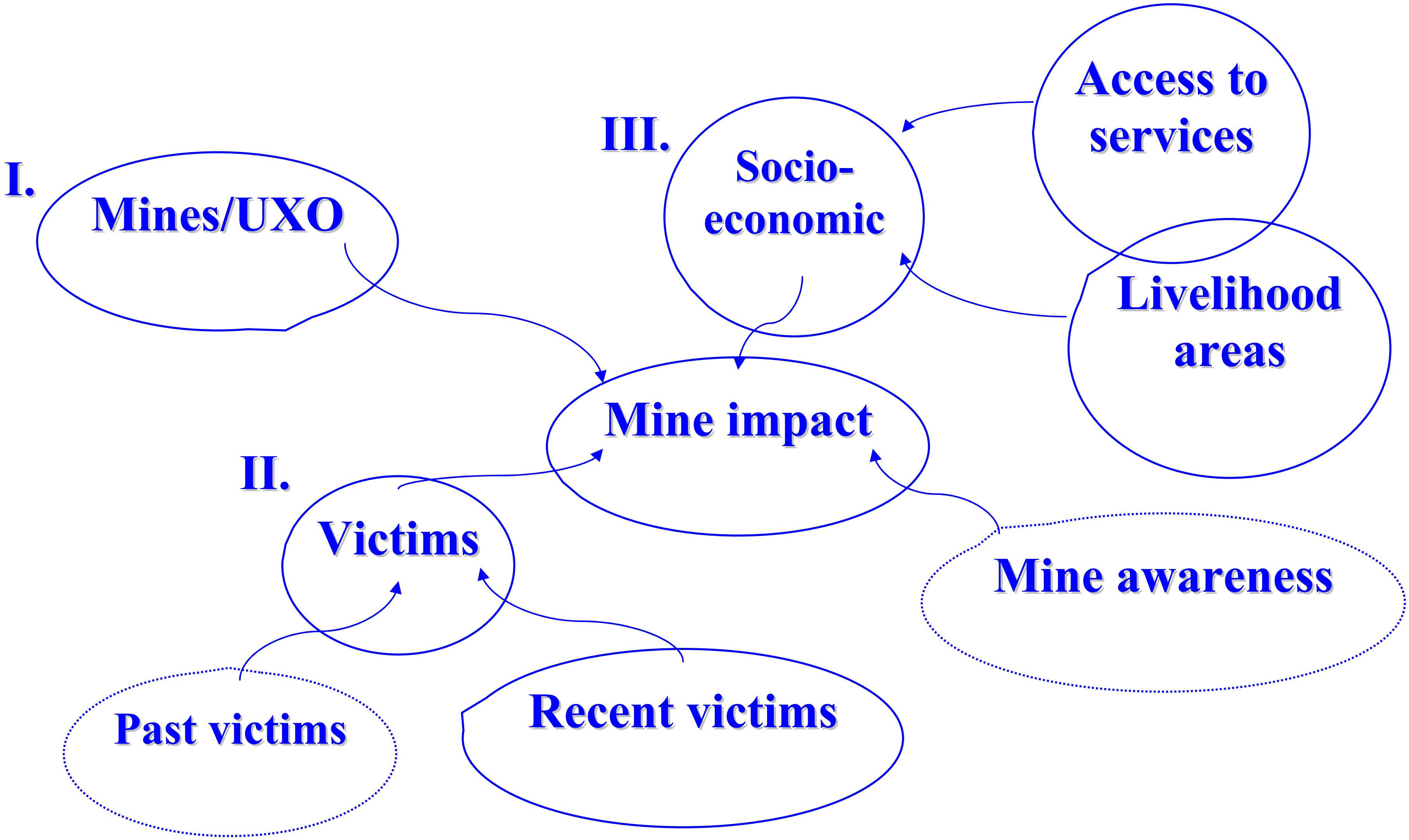
Technicalities

The Impact score is a property of the community, not of any or all of the mined areas in or around the community, nor of the victims that have suffered there. The score is indifferent to the number and size of the mined areas; it responds to these three aspects of the local mine problem:

- The nature of contamination;
- Sociio-economic blockages;
- The number of recent victims.

Technically, the score is a linear combination of two contamination variables (presence of mines, presence of UXOs), ten livelihood and institutional blockage variables, and of the number of recent victims. The first two groups hold binary variables, with values 1 and 0, to express statements of the kind: "Problem of type X does occur somewhere in the community - yes or no." The number of victims, by contrast, is their actual number counted over the past 24 months. The coefficients are the weights that users can set in response to their preoccupations and country conditions; the Survey Working Group has prescribed weights for some of the variables and has given rules for others that country surveys may set within limits (Survey Action Center 2000).

Influence diagram for the mine impact concept used in the Landmine Impact survey:



Previous page: An influence diagram of the concept of mine impact as used in the Impact survey. Data on contamination, recent victims, as well as on livelihood and institutional blockages is factored into the impact score. Some data is collected on victims of less recent date and on mine awareness education, but these do not influence the computation of the score.

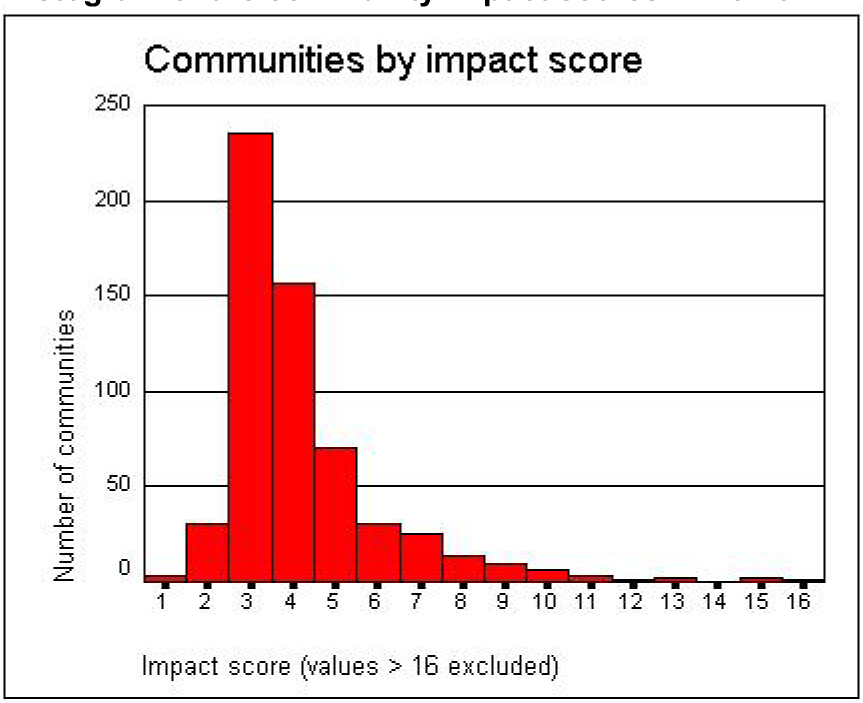
The 13 indicators of the score are

- composite truth values of qualitative statements, and
- the number of victims, over all mined areas in the community.

Some of them are truth values of indicators that are themselves composite statements from several more specific indicators. For example, "Some infrastructure is blocked" is true if some bridge, power line, factory or any other of several specifically enumerated infrastructure subtypes is blocked. In terms of statement calculus, the sub-type and mined area-specific statements are connected by "disjunction", the "or"-operator (Stoll 1961: 57); in the formal algorithm of the indexing machine the truth values of the composites are calculated as "x = IF(SUM(arguments)>0,1,0).

As an example of an actual result, the following graph displays the distribution of impact scores of the 592 affected communities surveyed in Yemen.

Diagram: Histogram of the community impact scores in Yemen



The left skew of the distribution is conspicuous. The majority of the affected communities in Yemen have low scores. Few communities (14) have scores higher than 10 and are considered, in the current classification, highly impacted.

Text and alphabet

The Impact score is a composite index, and the indicators that form part of it were chosen in the early days of specifying the mine information system requirements by persons who had "knowledge of the subject matter" (hence its claim to "content validity"), but may not have bothered about how to implement a formal algorithm. Many of the survey contributors and users, however, may at best be indifferent to, and at worst suspicious of, the way the indicators have been "hard-wired" into the IMSMA scoring algorithm. They may be confounded by the contrast between the limited freedom to set weights for the indicators on the one side and the inaccessible "black box" of the composite statement calculus on the other. They may intuitively understand the recent-victim variable, since counting and summing numbers is trivial, but are frustrated with the rest of the indicators.

They may be helped with an analogy: the relationship between a text and the alphabet. Suppose, for a moment, that the community key informants, for the accounts that they give the survey staff of the local mine problems, were using a special language. In this language, every type of mine problem would be represented by a particular letter, such as "blocked access to irrigated crop land" by the letter "L". Each unit occurrence of this particular problem, such as an acre of blocked irrigated land, would give rise to an instance of that letter. As the interviewees described their community neighborhood by neighborhood, field by field, they would form words using those letters. The more pervasive the mine problems to be described, the longer their narrative - while the more diverse the problems, the more letters are used.

What every student of the impact survey may want to understand, is the fact that the livelihood and institutional blockage component of the impact score is not "proportionate to the length of the text." Rather, it is proportionate, in a loose manner of speaking, to the scope of the alphabet. The number of different types, not the number of tokens, is what counts.

That particular metric, of course, is open to objections; and several of SAC’s critical supporters have pointed out the one or the other. Eric Filippino of GICHD gave the example of a farmer who found one mine in a corner of his orchard. He was still perfectly able to harvest the other 95% of his fruit trees. Nevertheless, his discovery made the same contribution to the overall score as would happen if mines put out of operation the entire non-irrigated crop land in his community. In other words, the index is too sensitive at the low-intensity end of mine contamination, and is not sensitive at the high end. It is not well calibrated.

Two considerations ease the problems of proper calibration. Firstly, within the limits of efficient and reliable data collection during most Impact surveys, there is no way to define meaningful units for the occurrence of mine effects other than recent victims. An exception may be made for fairly homogenous societies with long-standing mine action programs, such as irrigation-based rural Cambodia, where data on inaccessible farm area may be readily available. In general, however, the information economics of the impact survey will prevent more detailed measurement.

Mine impacts and type-token relationships

In the main text, the working of (parts of) the Impact score is compared to the relationship between a body of text and an alphabet. The quantitative side of relationships between corpus and vocabulary, or text length and types of letters used, is well researched in linguistics (see, e.g., Sichel 1986). Type-token relationships, as they are known, are meaningful in many other classes of natural and social phenomena. Species diversity and population densities are a case in point. Here we want to stick with text as a simile for the communities' mine problem narratives.

- Take, for example, the text string "The Global Landmine Survey". It uses, when capitalized and sorted by individual letters, the following 23: AABDEEEGH-ILLLMNNORSTUVY. Those are, in the terminology of type-token relationships, 23 tokens generated from the 17 types: ABDEGHILMNORSTUVY that occur in the string.

- In another community, the narrative may be longer: "The Global Landmine Survey will produce high quality survey data". This string is made up of 55 tokens: AAAAABCDDDEEEEEGGHHHIIIILLLLLLMNNOOPQRRRSSTTTUUUUVVWYYY using 21 types: ABCDEGHILMNOPQRSTUVWY.

- As we lengthen the narrative, it becomes obvious that the number of types activated increases very marginally: "The Global Landmine Survey will produce high quality survey data on the socio-economic impact of landmines" uses no fewer than 90 tokens: AAAAAAABCCCCCDDDDEEEEEEEEEFGGHHHHIIIIIIIILLLLLLLMMMMNNNNNN-OOOOOOOOPPQRRRSSSSTTTTTUUUUVVWYYY. They are generated from a mere 22 types: ABCDEFGHILMNOPQRSTUVWY.

The scope of the alphabet places an obvious upper limit on the number of types. This could, to a finite measure, be relaxed through the admission of foreign alphabets, but such outlandish additions would create a break in the frequency distribution of the different letters, and would also go at the expense of shared understanding.

The Impact survey impact score accepts to work with a "closed alphabet" of pre-defined mine impacts. It counts (and summarizes in a positive number) the types of different impacts, but has, with one exception, no grasp on the number of tokens, or occurrences. It is therefore, prima facie, a poor measure of the sum total of mine impacts in a community. What balances this shortcoming is the recent victims, who, exceptionally, are entered into the computation not as mere qualitative type data, but with their full natural number. The underlying assumption is that the "invisible" number of tokens, and therefore the true extent of the mines problem, is somewhat positively related to the number of victims.

However, this relationship is complex because it is mediated by the history of local learning about mine avoidance and livelihood alternatives. The number of victims, therefore, is no simple proxy for the underlying total mine impact. The score is a composite index, and only empirical analyses following the impact data collections in several countries will tell us more about the internal relationships. Pending that, as one observer teased, "it is all factor analysis by hand."

Secondly, societies learn. The hazard from mined crop land, to stay within our example, is not simply the static product of the number of people who depend on farming and of the square meters of unusable land. The ability to develop alternative livelihoods will be a complex function of population size, institutional endowments, and response to previous mine accidents. Thus, even if the mined surfaces were exactly measured, the respective damage to persons and livelihoods would likely be less than proportionate to their actual areas.

An intuitive approach to the Impact score

Some readers may find it easier to understand the score when they look over the shoulders of enumerators who do the actual calculations in the field. Enumerators use forms like the one below. In the weights columns, weights will have been defined for them, on a country-specific basis, for the ten institutional and livelihood areas enumerated. Later, the scores will be recalculated in the database.

Locality identifier: **District:** **Community:**

Indicators		Weights		Points	Score
The community reported that				to add	
there were mines.	If so, give	2	points	_____	
there was unexploded ordnance.	If so, give	1	point	_____	
		Subtotal for realm:		explosives	_____
access to some irrigated crop land was blocked.	If so, give		points	_____	
access to some rainfed crop land was blocked.	If so, give		points	_____	
access to some fixed pasture was blocked.	If so, give		points	_____	
access to some migratory pasture was blocked.	If so, give		points	_____	
access to some drinking water points was blocked.	If so, give		points	_____	
access to some water points for other uses was blocked.	If so, give		points	_____	
access to some non-cultivated area was blocked.	If so, give		points	_____	
access to some housing area was blocked.	If so, give		points	_____	
some roads were blocked.	If so, give		points	_____	

access to some other infrastructure was blocked.	If so, give		points	_____
Total number of points (sum of weights) to be equal to		10		
		Subtotal for socio-economic realm		_____
there were ____ mine victims in the last 24 months.	Multiply with	2		_____
		Points for victims		_____
		Total impact score:		_____

If the impact score is 0, rank the community as having "no known mine problem"
If the score is between 1 and 5, the impact is considered to be "Low".
If the score is between 5 and 10, the impact is considered to be "Medium"
If the score is higher than 10, the impact is considered "High".

Impact ranking: _____

In other words, the impact score as a largely qualitative measure may be more valid than it would seem at first glance. Its validity, however, will be restricted to the objectives of the impact survey to create a meaningful ranking of communities in terms of mine impact. It will not characterise a community very well for the purposes of a technical survey.

This discussion is important because other systems of indicators for mine action will be faced with similar problems. Whatever the system, it will need to define rules for qualities (types of problems) and quantities (counted or measured tokens). It may imply hazard and utility assumptions that are non-linear. It may need rules for connecting statements that are far from obvious. The current impact score, however imperfect, illustrates how such a calculus can be implemented. Nor does the impact survey stand alone in its use of weak metrics; the use of softer “presence / absence” type of data is recommended in many situations where “high quality quantitative data [is] expensive, intrusive, or otherwise impractical to obtain” (Orwin et al. 1998; 246).

Compassion

The discussion so far has been technical. Given the fact that the impact score takes more than ten substantively different indicators, this is understandable.

However, the technicalities are less important than the basic intent of the impact score, which lies in arousing and informing human compassion. The survey, through the design and use of the impact score, purports to signal communities who have, by several standards, suffered greatly from mines. It elevates these communities for priority attention of the mine action community. The working assumption is that communities scoring high on this index are also the ones in which mine action has a greater potential for reducing future suffering.

The symmetry between past situations and future potential is, of course, not unique to the impact score, but is key to the functioning of a number of organized systems of social memory. Educational testing, credit rating, codification of styles in art and science come to mind, among others (Luhmann 1996: 319ff.). Commonly, such systems display two important characteristics: They accept a measure of oscillation, such as in a series of good and bad school marks in the same student, or between the score of the impact survey and the new insights that later mine action contacts with the same communities may produce – in other words, they demand a good, but not too high, predictive validity.

Secondly, they need to be able to portray past history as a kind of living present into which future actions and outcomes can be integrated – and it is probably, at a deeper philosophical level, this factor which bred disappointment with the old generation of general mine surveys, prior to the socio-economic perspective. What is more unique of the survey, is the interpretation of the future potential in terms of human suffering and its reduction – as opposed to specific numeric expressions in terms of recovered production, saved lives, or development funds disbursed.

The compassionate character of the Impact score may be a blessing in disguise. The weak metric makes it nearly impossible to place a value on human lives and therefore does not open arguments between proponents of accident prevention and those who prefer livelihood rehabilitation. Imagine a different survey that uses a stronger metric in the form of cost-benefit analysis. In some rural communities, high-value irrigated farms represent a small number of recent victims, simply because previous accidents let the community know which areas they should avoid. On the other hand, women collecting firewood from vast tracts of low-value shrub land may keep stepping on mines with shocking frequency. Given a limited budget for demining, assumed costs of demining and net present values for different types of land, and failure to develop alternative household energy sources, the cost-benefit analysis will imply a trade-off between capital investment and human lives. The metric of the Impact survey avoids, or at least postpones, such thorny debates.

Communities as basic units of the survey

The case for community-level indicators

It could be argued that a description using only individuals and mined areas could do the landmines problem better justice than a community-based survey does. In such an arrangement, communities would at best provide convenient addresses for victims, survivors, landowners and perhaps other sets of interested persons as well as for the mined areas. Surveyors would not have to bother about the nature and boundaries of communities, or about the effects that mined areas have on people other than the most seriously afflicted individuals. Philosophically, an individually-based description might be more in tune with modern times. Images of survivors with a personal identity tell the strongest stories, and on-site mine action requires the identification of individuals for such things as medical aid and land ownership. Within given communities, not all individuals are equally affected, and differential impact may be more finely characterized in terms of social status than by inclusion in a community with a summary impact score.

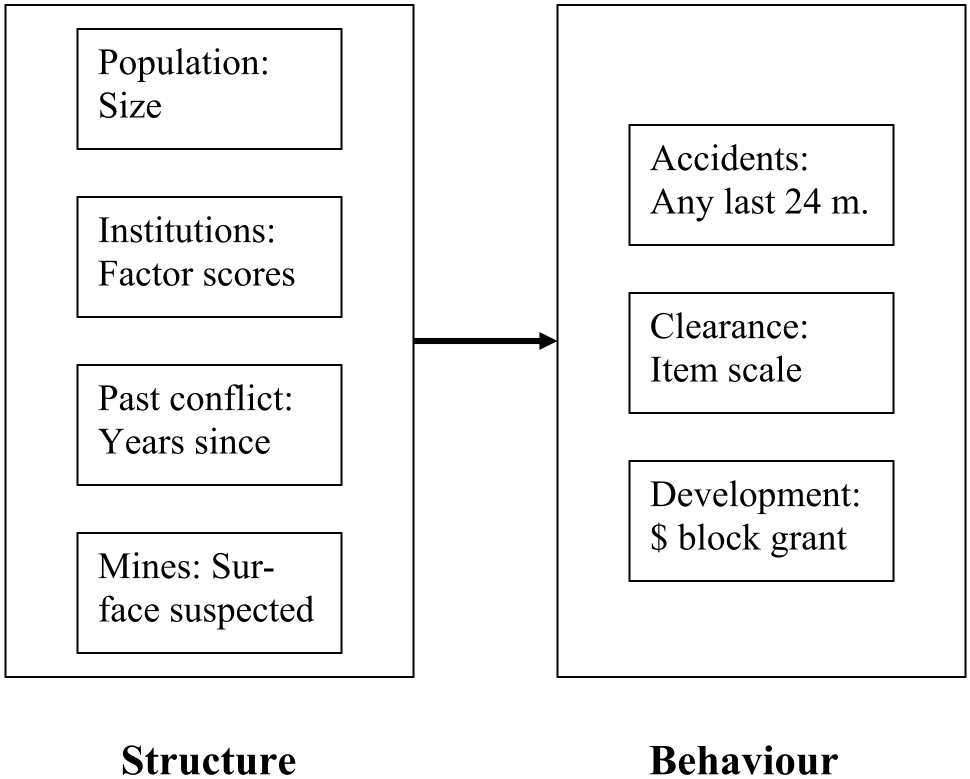
There are several reasons why a community-based description and analysis should be pursued. Most trivially, and powerfully, the mine action community depends on estimates of the affected population. At the required level of aggregation, it is difficult to see how this figure could be established other than as the population of all the affected communities. The total may be broken down by communities of greater or lesser impact, but the need for some global figures will not go away.

Less obvious is the fact that communities are aggregate actors that solve individuals' mine problems. Despite dependency on outside markets and bureaucracies, individuals and families survive, by and large, thanks to institutions that are controlled by their local community. The nature and strength of these institutions, and their measurement within the limits of key informant interviews, should therefore be of concern to the impact survey.

Relationships that exist between the community characteristics and behaviour toward landmines form a background on which it may be easier to validate the Impact score. For example, do the scores for the affected communities show a similar distribution to the one that we find for the probabilities of mine accidents? Would it be similar to the one for local demining effort, if we could construct an index for this, proving that severe impact goes together with extreme risk-taking in order to open more roads and lands? Would a similar correlation be established between the impact score and the amount of approved development budgets that cannot be spent because of mine problems?

The following graph exemplifies a possible "structure drives behaviour" model. In each box, concepts are not complete, but some are given as examples, together with a possible measurement. Note that the impact score is not part of this diagram; it is not a member of either the structural or behavioural sets, but is a hybrid formed of elements of both. Its validation will therefore remain difficult and, in many contexts, probably inconclusive.

Diagram: A model of structure and behavior in mine-affected communities



Community-level factors: The example of Yemen

Such questions were investigated, in a small measure, in the Yemen survey. The leading hypothesis was that the probability of mine accidents did not only depend on the number of mines and the size of population living near them. The risk would be reduced by the amount of time the communities had had to adapt to the local contamination and by the strength of the institutional endowment. Unfortunately (for reasons of survey design, not of data collection performance), not enough good data was available on other behavioural variables such as local demining effort or impaired development spending. Therefore it was not possible to build parallel models for cross-validation.

For the accident model, the following concepts were used and measured, with data available for almost all of the 592 affected communities:

Concepts	Associated variables
Pressure on resources:	
	Size of population
	Access to water bodies blocked
Intensity of past conflict:	
	Contaminated area
	Distance of nearest mined area to center of community
	Years since mines last laid
	Distance to nearest (other) community with some recent mine victims
Institutional endowment:	
	Degree of institutional modernization
	Degree of technical modernization

"Distance of nearest mined area to centre of community" was discarded because it was difficult to interpret in the case of dispersed village communities. The two institutional modernization variables are ex-post interpretations of a factor pattern.

The conduct of armed conflict in the region is less straightforward in its influence on the local ability to avoid mine accidents. The basic idea is that the intensity of conflict is spatially concentrated, and that this extends to the density of mining or UXO littering. Therefore, if the accidents in this community and in this period are only one sample realisation of the local hazard, the accidents in neighbouring communities are significant covariates of the local hazard, too. This measure may be proxied by the distance to the nearest other community with recent mine victims.

Turning to the subject of institutional endowment of surveyed communities, in Yemen eight indicators were used:

- Is the community an ordinary village, or is it the center of a higher administrative tier (sub-district or upward)?
- Does the community have a primary school?
- Does the community have a secondary school?
- Does the community have a health care facility?

- Is the community connected to a telephone service?
- Do at least some of the households have access to piped water supply?
- Do at least some of the households have electricity?

The selection of those indicators followed predefined fields in the database rather than a theoretical framework already validated in other community studies, but the indicators were thought to be sufficiently diverse at least for an exploratory analysis. This was done using principal component analysis:

Table: The institutional endowment of mine-affected communities

Variable	Communities with	Rotated Component Matrix **Institutional**	**Technical**
Has secondary school	15%	.75	.09
Is ordinary village	90%	-.72	-.10
Has health care facility	17%	.69	.21
Has primary school	56%	.59	.06
Fuel is available	11%	.47	.47
Has telephone service	9%	.21	.66
Has piped water supply	19%	.06	.76
Has electricity	24%	.06	.80
Variance explained		36%	16%
Correlation with log of current population		.48	.32

Note that "fuel" loads almost equally strong on both factors. It is shown under the institutional factors for mere conventional reasons.

The results regarding accident probabilities are fascinating:

- The strongest influence is exerted by the regional conflict history. In other words, the risk of new accidents increases considerably if neighbouring communities too have suffered mine accidents.
- The infrastructure / technology endowment and the access to water bodies come second and third in terms of influence. Their influence is closely followed by that of the length of the post-conflict period and of the estimated polluted surface.
- The size of population is positively associated with accident proneness, but very weakly so[1]. The institution of private property may reduce opportunities to interact with mined terrain for all but the legal owners, and thus even if the population is large, not many more people will walk into privately or group-owned mined territory. But this is mere speculation. This result can be read also as "No mercy for small communities."

[1] Some of the models using the number of recent victims do suggest that increasing population size significantly increases the mine accident risk. The question of big vs. small communities, therefore, has to be reevaluated carefully when it comes to utility questions in resource allocation.

- However, it is far less disturbing than the finding that the degree of institutional modernity does not mitigate the mine impact, at least not as concerns accidents. This is a slap in the face of conventional wisdom. It suggests that the presence of government personnel does not enhance the communities' problem-solving capacity in the case of landmines.

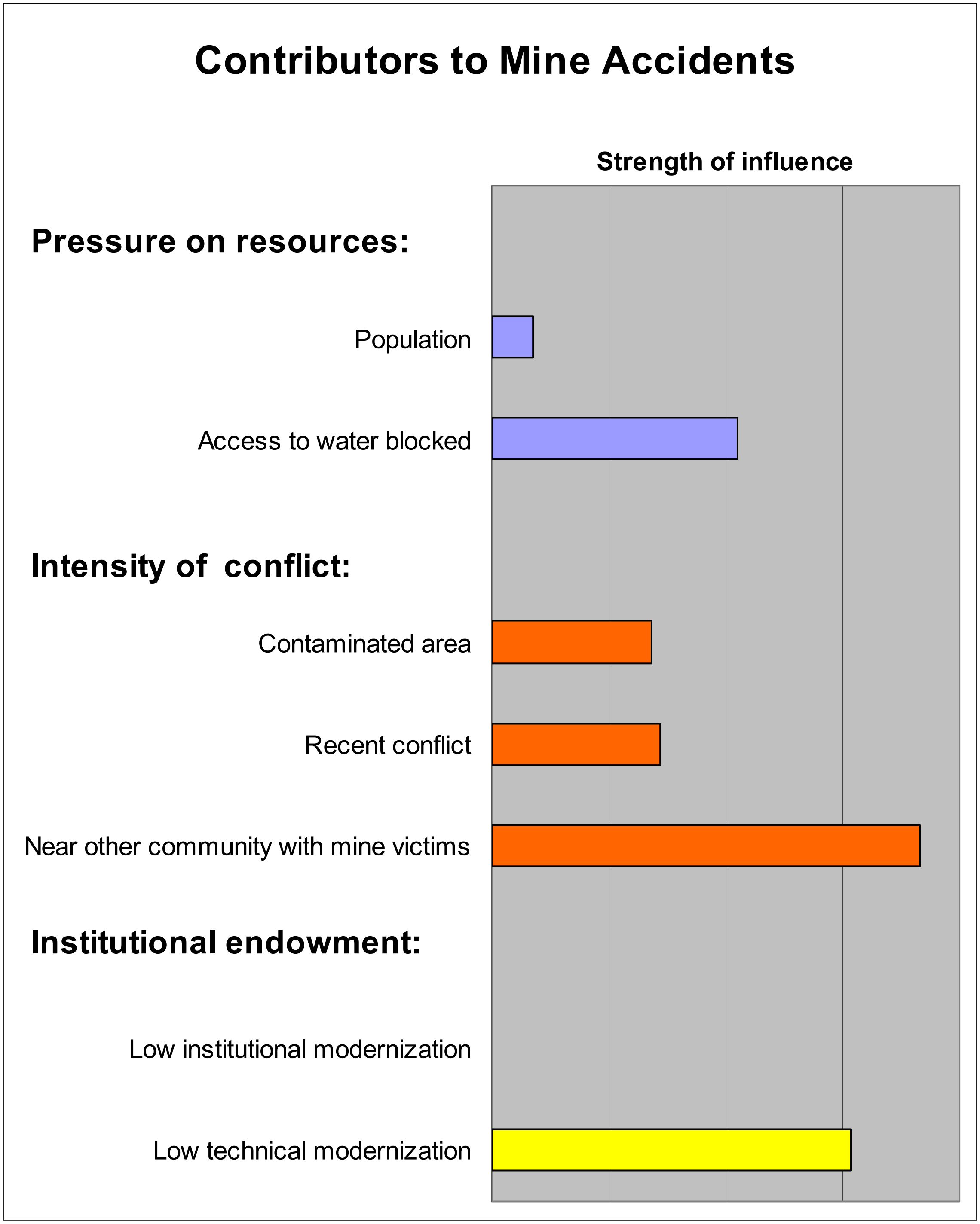
The following graph visualises the proportional influence of these factors[2]. Each is phrased in a way that makes its presence a contributor to the accident risk. For example, "recent conflict" stands for the number of years since mines where last laid (because the longer the post-conflict period, the smaller the accident probability). The factors are grouped into larger domains: "Pressure on resources", "Intensity of the conflict", and "Institutional endowment".

[2] The length of the bars is proportionate to the regression coefficients of the logistic regression model:

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
Log10 Distance to nearest other town with recent victims	-0.7508	0.2424	9.5940	1	0.0020	-0.1284	0.4720
Technical modernization	-0.4238	0.1554	7.4354	1	0.0064	-0.1086	0.6545
Access to some water blocked	0.7376	0.3478	4.4986	1	0.0339	0.0736	2.0909
Years since mines were planted last	-0.0305	0.0171	3.1858	1	0.0743	-0.0507	0.9700
Log10 Total estimated mined area surface	0.2111	0.1208	3.0543	1	0.0805	0.0478	1.2350
Log10 Current Population	0.3990	0.2776	2.0665	1	0.1506	0.0120	1.4904
Institutional modernization	0.0786	0.1564	0.2525	1	0.6153	0.0000	1.0818
Constant	-3.0405	1.0400	8.5477	1	0.0035		

-2 Log Likelihood	425.006
Goodness of Fit	617.757
Cox & Snell - R^2	.059
Nagelkerke - R^2	.109

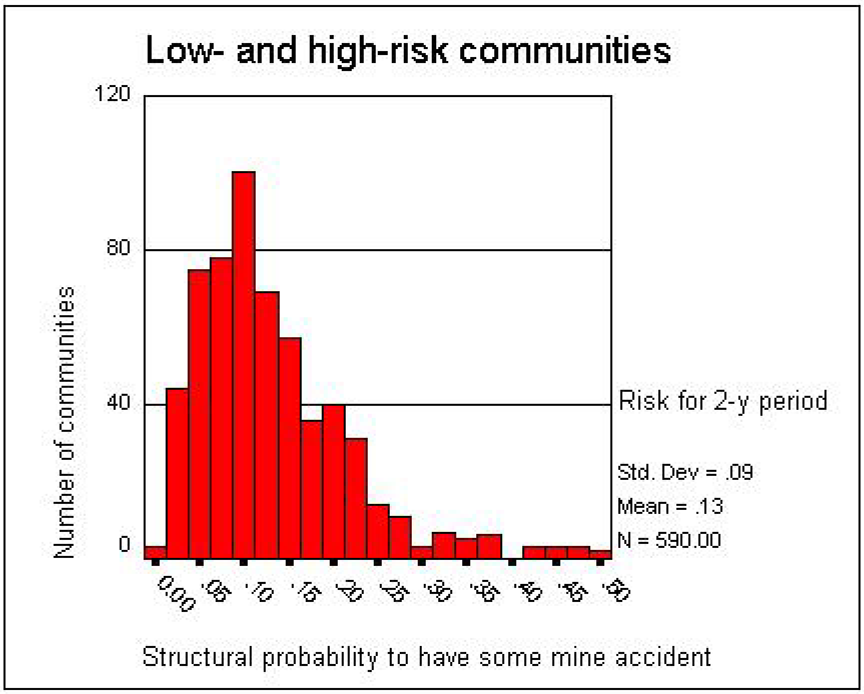
Diagram: Strength of community and conflict background variables, Yemen



On the practical side, the results suggest the need to carefully investigate several policy and practical consequences: the need to take technical survey resources not only to communities classified as highly-impacted, but also to their neighbours; higher weights for blocked access to water, and the creation of alternative employment via technical investment rather than full-scale demining.

For the discussion of socio-economic indicators, one other result seems noteworthy: The distributions of the estimated probability for a community to have at least one mine accident in a 2-year period and of the impact score are both heavily left-skewed, in spite of the fact that the two measures are largely independent the one from the other. This would lend credence to the validity of the Impact score as a realistic measure of the harm reduction potential.

Diagram: Probabilities for communities to have mine accidents



The impact score histogram appeared on page 11.

Through this kind of analysis, the Yemen survey also vindicates the possibility of a structural sociology of landmine-infested communities. Some may want to place such an effort in some more sophisticated framework such as the neo-Durkheimian trinity of differentiation, pluralism and solidarity (as Frank W. Young in his life-long study of small communities has done; Young and Young 1973, and Young 1999). Others will prefer to travel without much theoretical baggage. The choice is a matter primarily of taste, data availability, and the tolerance of practitioners for socio-speak. The Impact survey design has been content to seek basic information with which to characterise the institutional endowment, and therefore local problem-solving capacity, of the affected communities. However, it is difficult to see how in the long run the Global Landmine Survey can build bridges to development cooperation and program evaluation, without validated indicators that speak understandably to those foreign worlds.

More theoretical development seems necessary, perhaps on the lines of some of the community behaviour work done in rural sociology, notably O'Brian on outside network influences 1991 and Zekeri et al. 1994 on the connection of past history and development efforts. The latter work with confirmatory factor models should be explored for models of mine-affected community behavior and for indicator design to supply the relevant data.

Non-communities: The work-around in Kosovo

The concept of communities as social groups capable of self-description is central to the impact survey methodology. However, this is not always the case. In Kosovo, immediately after the return of the refugees in the summer of 1999, foreign military and relief organizations knew more about the landmine and UXO contamination than the Kosovars did. Also, many returnees stayed in temporary settlements away from their former communities. Truly knowledgeable local key informants were rare.

The Modified Level-1 Impact survey and the methodology that the UN and SAC had to adopt for it are detailed in Messick 2000. Here, only a few observations are pertinent regarding the use of socio-economic indicators in those circumstances.

Communities were not investigated through key informant interviews, not only because of time and information constraints, but also because of conceptual problems. In a province with a history of violent opposition between state and ethnic groups, an authoritative list of communities with which local people – supposing they still lived there – would identify was not available.

That social baseline was replaced by physical data on settlements, roads and land-use, chiefly extracted from satellite imagery, and by data on the lowest administrative tier for which polygon shapes and (incomplete) population estimates were available. In Kosovo, the survey was done over 300 units known as districts.

As a result, the analysis that led to mine action priority setting relied heavily on spatial constructs. The administrative units for which priority rankings were worked out were different:

- Suspected areas in the case of area reduction and clearance, and
- Districts in the case of mine awareness education.

The metrics used were stronger than that of the impact score in a normal impact survey – for the classification of districts, the percentage of contaminated land was used. The score used for the suspected areas was a composite index with a weaker metric, but the validation of its components relied on strong metrics. Not all of the validations were straightforward, however, and more precise measurement did not always mean that the concepts were easier to understand (see again Messick 2000).

The scoring variables themselves, and their validation correlates, depended on remote and unobtrusive measurement, at least until the results of aggressive area reduction through community visits were included. Except for the awareness education sites, the accident locations, incomplete district population updates, and post-return incident and suspected area reports, nothing from the post-conflict society influenced the data and the analysis. Notably, systematic and useful data on types of mine impacts other than those inferred from distance to settlements and roads and from land use was not available.

Initially, the data on suspected areas and on accident locations was of modest reliability, but this improved with increasing visits of organisations in different branches of mine action. These improvements were not accompanied by significant acquisition of social data. This was so notably because sector-specific relief and reconstruction agencies did not have relevant data or failed to translate it to a common reference.

The Kosovo survey attained its objective to provide decision tools for mine action, and it did so within the time limits, by creatively exploiting a limited pool of data. Some of the spatially defined data, such as land use, was ready only after several months of inter-agency diplomacy. During the same period, other data slowly improved in reliability and completeness.

The point is, however, that despite stronger metrics to begin with, and improved reliability over time, small gains were made in validity and sophistication of the underlying socio-economic model. Such gains can hardly be expected from a survey that cannot gather enough knowledge from the affected populations themselves.

That was not a major problem in Kosovo, where mine action resources were plentiful, and agencies could be directed to interventions when new information became available. Unobtrusive measurement of physical variables may be more rapid or cost-effective than interviewing local residents. One can speculate that this will increasingly happen if and when aerial detection technologies become available.

A related, less obvious scenario arises when mined areas are very large. Each of them may affect several communities. The physical characteristics of such areas may be relatively well known, but the attribution of impacts, either to the individual mined area based on what it does to a plurality of communities, or to the individual community, which shares the same resources with many neighbours, may be challenging. This seems to be the case, for example, in the border area between Thailand and Cambodia. In principle, a dual approach should be feasible: a survey of communities each rated by the normal score (multiple counts of the same mined area do not disturb this process), as well as a scoring of mined areas, using spatial metrics and population weighting. The system for this has not yet been formulated.

A computer simulation: The information value of Landmine Impact survey indicators

Although the reader may by now understand the logic of the Impact score, the question of the value of the survey information is not yet answered. Surveys are expensive, and SAC gets to hear that occasionally when donors (or NGOs who believe in the unlimited fungibility of mine action budgets) see price tags. Too rarely, however, are questions asked about the value of the returned information, and about how this or that design intervention might affect survey validity and reliability and thereby its value.

A computer simulation of the informational value of the impact survey using the Impact score addresses this. In a hypothetical world populated with mined communities, two utility variables are evaluated against different information scenarios. These dependent variables are:

- The reduction in loss of life and health, measured as the difference between the number of victims in the past 12 months and the zero victims once the community has been completely demined;
- The net present value of demining, defined as the present value of the income of demined cropping land and roads minus the cost of demining them.

A limited budget is voted for the total effort of demining in all scenarios. Communities are assigned for priority demining using different criteria.

- A **random-sequence scenario** uses no prior knowledge about the communities; it picks them in a random order from the list and continues demining until exhausting the budget.

- A **minimal-knowledge scenario** uses the government census as prior information; it assigns communities by decreasing population size, on the assumption that mine hazards and road-demining benefits are positively correlated with population. It has the same budget limit as above.

- The **Impact survey scenario** selects communities starting with those of the highest impact score. It has the same budget limit.

- The **perfect-knowledge scenario** is the baseline. It uses the entire knowledge simulated into the data set.

However, since no monetary value of saved lives is permitted, the last scenario has to choose between a maximum economic benefit and a maximum accident reduction strategy. Both are possible; here we explore the economic strategy because it approximately follows what a decision-maker with additional Technical Survey information could do. In other words, this scenario assigns communities by descending present value of demining.

The budget for those scenarios is arbitrarily set to equal the cost of the first 20 communities in the perfect-knowledge scenario. The absolute values of the costs and benefits are almost irrelevant; what matters are the proportions between the scenario results. Several simplifying assumptions were made. One of them is that communities are either completely demined, or not at all. Other assumptions are discussed in the box on the next page.

Only demining is considered among the selection of mine action activities. The economics are limited to physical capital; the cost and benefits of victim care,

Simulation parameters

A hundred communities were populated in a spreadsheet. Population was distributed lognormally, with a average population of 1,704. Every community had a chance to have up to three mined areas in low-value (e.g. pasture) land and one in high-value irrigated land. It could have some mined roads. Other types of mined areas were not included. The two land types were selected because they differed in economic benefits of demining, but all land-based benefits were thought to be proportional to the surface demined, assuming constant unit productivity. Roads were selected as a different type of mined area because their demining costs may be proportionate to length of mined sector, but their benefits are likely to be correlated with population size (This assumption is made in Mine Clearance Planning Agency 1998). In the run that was retained for the cost-benefit modeling, 94 communities had some mined areas, 6 were “false positives”.

The size of mined areas and the length of mined road segments was also simulated using lognormal distributions. They were not correlated with population size. A different distribution – Poisson (using the Morgan et al. 1990: 92 formula for random samples) – and different associations were used for victims. Total victims from before 12 months were simulated as a sample from a mean hazard that varied with the product of power functions of population size and of a linear combination of mined area and mined road length. The power functions were to express collective learning effects and livelihood alternatives. Recent victims were simulated using a similar process, but including the learning from old accidents. The exponents used for population, mined areas/roads, and old victims were 0.1, 0.33, and –0.2 expressing learning effects that in retrospect may have been unrealistically strong. In the sample run retained, that created 308 old and 74 new victims, or less than 1 new victim per year and community.

The weights used for the indexing machine were the SAC default: 2 for irrigated land blocked, 2 for the number of recent victims, 2 for the presence of mines, 1 for all other variables.

Economic parameters assumed equal cost to demine irrigated and other land units, and returns on irrigated land double that on other land. Returns on demined roads was per inhabitant. Because of that, and of the fixed set-up cost charged for every village, net benefits were negative for some villages. Within each scenario, sequential demining would stop short of tackling the first community to cause a budget overrun.

rehabilitation, and secondary effects on families are considered to be absorbed into the victim reduction variable. However, for a proper understanding of the model, it may be wise to state a principal difference: while, in the model, demining has only positive effects on hazard reduction, its economic value may be negative in some communities that have, for example, long stretches of road mined but have only small populations to benefit.

The results are summarized in the table below. The perfect-knowledge scenario gives priority to high net-benefit communities; it spends most of its budget on a small number of communities with high demining costs but also high returns.

By contrast – and this is the interesting part -- the Impact survey portfolio is strongly drawn to communities that had comparatively many recent victims. It has a low preference for communities with high economic benefits from demining. The reason is that the impact surveyors do not effectively pick out such communities. The kind of information they are able to collect at this stage, and the qualitative scoring of the livelihood and institutional blockages, do not flag high-benefit communities of this type.

The population-based minimal-knowledge strategy does a better job than the perfect-knowledge strategy, simply because of a correlation between population size and recent victim numbers. The random-sequence strategy exceeds the Impact survey portfolio in economic benefits. There are sample fluctuations in this scenario, of course, but it did better also in a second run.

Table: Results of five scenarios

Scenario	Communities demined	Cost of demining	Returns from demining	Net benefit	Annual victim reduction
All communities	91	1,524,579	2,872,508	1,347,929	74
Perfect knowledge	20	706,985	2,416,006	1,709,021	22
Impact survey	38	600,947	985,062	384,115	59
Minimal knowledge	37	623,977	809,040	185,063	37
Entirely random	40	591,423	1,003,612	412,189	34

Many of these outcomes are variable with the model parameters, and more experimentation would be needed to explore sensitivities. However, two findings may be repeated in order to advance a tentative consequence:

- The Impact survey-based portfolio does better in accident reduction than a purely economic benefit maximizing strategy. By implication, it does worse in terms of economic returns;

- It does better in accident reduction than a purely random selection of communities. However, it does not do any better in picking communities with good economic benefits from demining.

In consequence, between the impact survey and a cost-benefit analysis of demining particular physical assets in the affected communities, there need to be bridging elements. A cost-benefit analysis would require information, for example, on farm productivity, precise surfaces and prices in the local property markets, things that the survey does not collect.

It follows that the impact survey, if one looks only at the impact score using current definitions, has value for the qualitative, compassionate, and victim-related mobilization of mine action resources for affected communities. Information needed to make cost-benefit based decisions for physical asset demining will need to be collected in another step such as during a technical survey.

The results are very tentative. They are based on a simulation that has not widely varied its parameters, and has not done a great number of runs with the set parameters. However, more analysis is needed of the inferential potential of the survey data, and this will be facilitated when the correlation among indicators become empirically known from the first country surveys completed. It is desirable that developers of other indicator systems do similar investigations of their information value. As a form of such exercises, computer simulation should be used aggressively.

Conclusion

The Impact survey as part of the Global Landmine Survey has moved from design to testing and to data collection in several countries. The survey has been completed in Yemen, and, in a modified format, in Kosovo. Several other surveys are under way, each demanding and making an amount of conceptual adjustments while trying to stay faithful to the core requirements. The relevant organisational environment, is also evolving, and in this co-evolution the survey design is not above challenge even at a time when the first complete surveys garnered international applause.

Table: Communities and populations in Yemen, by impact categories

Impact category	Communities	Affected population
High	14	35,892
Medium	84	117,503
Low	494	674,399
Total	**592**	**827,794**

One of the simplest results of an impact survey is also one of the most important: A breakdown of affected communities and their population by the severity of the landmine impact.

The core logic of the survey, and the one "hard-wired" into the database, uses a weak metric to assess degrees of mine impact. The weak metric is part of the price paid for a community-centered approach. It allows the calculation of a Impact score that is both a qualitative and compassionate construct. Also, it keeps information costs down during this phase. It can inform a community ranking for priority mine action, but within this selection special surveys may be needed subsequently for victim assistance needs or for the selection of specific area for clearance considering costs and benefits.

The weak-metric approach is easy to criticise, but difficult to replace. Elements have been injected into the survey format that threatens mission creep and hybridisation while improving the commonality with some of the mine action professions. The international survey management will need to keep a good balance between stability and improvement of a standard design on the one hand, and openness and creativity on the other.

Alternative indicator systems to the one used in the Impact survey are perfectly conceivable. Whatever their logic and metrics, the fundamental challenges will remain similar. There is painfully little valid theory of the behaviour of mine-affected communities around in which to ground conceptual frameworks and indicator systems. The Yemen survey has proven that advances are possible. Nevertheless, the challenges of relevancy, validity and reliability will remain omnipresent. The unit costs in a particular line of surveys will go down with replications in more countries, but new needs may also come up for sequential products. New efforts will be needed, not only for technical information, but more so to keep the flame of compassion burning.

2 January 2001

Bibliography

Global Landmine Survey, Global Landmine Survey [Information sheet], Washington, DC, Survey Action Center, 1998, 2 pp.

Litwin, Mark S., How To Measure Survey Reliability and Validity, Thousand Oaks, SAGE Publications, 1995, 87 pp.

Luhmann, Niklas, Zeit und Gedächtnis, Opladen, Soziale Systeme, 2/2, 1996, 307-330

Messick, Shawn, [With the assistance of:] Aldo Benini, Charles Conley, Larry Moulton, Final Report. Modified Level One Impact survey: Setting Mine Action Priorities In Kosovo. Survey Action Center Support For The United Nations Interim Administration Mission In Kosovo Mine Action Coordination Center. 31 March 2000, Washington DC, Survey Action Center, 2000, 122 pp.

Mine Clearance Planning Agency, Socio-Economic Impact Study of Mine Action Operations in Afghanistan. Interim Report. October 1998, Islamabad, United Nations, 1998, 31 pp. + appendix

Morgan, M. Granger, Max Henrion, Mitchell Small, Uncertainty. A Guide to Dealing with Uncertainty in Quantitative Risk and Policy Analysis, Cambridge, Cambridge University Press, 1990, 330 pp.

O'Brien, David J., et al., The Social Networks of Leaders in More or Less Viable Rural Communities, Rural Sociology, 56/4, 1991, 699-716

Orwin, Robert G., L. Joseph Sonnefeld et al., Constructing Quantitative Implementation Scales From Categorical Service Data. Examples From A Multisite Evaluation, Evaluation Review, 22/2, April 1998, 1998, 245-288

Sichel, H.S., Word frequency distributions and type-token characteristics, Mathematical Scientist, 11, 1986, 45-72

Stoll, Robert R., Sets, Logic, and Axiomatic Theories, San Francisco, W.H. Freeman and Company, 1961, 206 pp.

Survey Action Center, Survey Working Group Impact Scoring and Community Classification. Protocol Document # 15. 27 June 2000, Survey Action Center, Washington DC, 2000, 19 pp.

Young, Frank W., Small towns in multilevel society, Lanham, Md., Oxford, University Press of America, 1999, 160 pp.

Young, Frank W., Ruth C. Young, Comparative studies of community growth, Rural Sociological Society monograph ; no. 2, Morgantown, West Virginia University, 1973, 137 pp.

Zekeri, Andrew A., et al., Past activeness, solidarity and local development efforts, Rural Sociology, 59/2, 1994, 216-235