Chapter 2

Assessing the impact of mine contamination

Mine action management can be as much about information as it is about landmines — and acquiring comprehensive bases of information is a major struggle in the early days of mine action programmes. To strengthen the information baseline, Landmine Impact Surveys can effectively assess the scope of contamination and help identify communities for priority attention by mine action programmes. This chapter, based on a submission from Aldo Benini of the Survey Action Center (SAC) in Washington DC, describes the concepts, techniques and constraints of Landmine Impact Surveys, which represent the core of the Global Landmine Survey process being managed by the SAC.

Introduction

Some 60 countries, especially in the developing world, are currently affected to a greater or lesser degree by landmines and other explosive remnants of war. The widespread use of landmines and/or the presence of UXO typically results in prolonged and acute social, economic and environmental harm extending far beyond the localised human suffering commonly inflicted by other conventional weapons. They impact negatively on development, obstructing post-conflict rebuilding, and the provision of, and access to, health and education, rendering fertile agricultural land unusable, and impeding the free circulation of goods and labour And the high levels of disability that result, in particular from the use of anti-personnel mines, affect not only the individuals caught in a mine blast but also their families, and in turn, their communities and society at large.

Yet, not all mine-affected countries and communities suffer equally Some are better equipped — and resourced — to deal effectively with the threat than others. And since international funding is limited, careful attention must be paid to determining who is most in need of outside assistance, and with what level of urgency. As a consequence, from its inception, mine action has sought to quantify the scope and nature of the threat posed by landmines and UXO as part of the requisite planning and prioritisation process. Initially, assessments tended to be formulated in terms of numbers of mines. Notoriously, these early estimates were often found later to be exaggerations, and quantities of explosive remnants of war did little to categorise the threat posed to communities. Later, the size of areas of land suspected to be contaminated was calculated, but still the information provided was inadequate.

Planning for mine action requires accurate and timely information on the form, scale and impact of the threat posed by mines, UXO and other explosive hazards. Such information will come from assessment missions and surveys, from ongoing local demining and mine awareness projects and tasks, and from local knowledge. Surveys involve the systematic collection, assessment and processing and recording of information. The information gathered from mine action surveys will normally be "owned" by the national mine action authorities, and should be made widely available

The definition and categorisation of mine action survey have developed, and continue to develop, to reflect the changing requirements and perspectives of the international mine action community

In July 1996, international standards for the survey of mined areas were proposed at a conference in Denmark. These proposals were taken forward by a United Nations-led working group and incorporated with other recommended procedures, practices and protocols into the United Nations' *International Standards for Mine Clearance Operations*. The standards proposed three levels or functions of survey: a general (level 1) survey to collect information on the general locations of suspected or mined areas; a technical (level 2) survey to determine, accurately delineate, and, if possible, mark, the perimeter of mined locations initially identified by a general survey; and a completion (level 3) survey to accurately record the area cleared.

Not long after these standards were published, it was recognised that the survey process should not only define the form and scale of the mine and UXO hazardous areas, but should also address the impact on individuals and communities affected by the mines and UXO. This important change in emphasis was led by the Survey Working Group, which represented a group of NGOs active in mine action. The experience gained over the last three years has been invaluable in understanding the needs, scope, and indeed the limitations, of mine action survey at national and local levels.

These lessons learned are reflected in the revised International Mine Action Standards (IMAS). IMAS has dropped the terms level 1, 2 and 3. Instead, it uses the terms ***national survey***, ***technical survey*** and ***post-clearance documentation***

A ***national survey*** is defined as "a comprehensive inventory of all reported and/or suspected locations of mine and UXO contamination, the quantities and types of explosive hazards, and information on local soil characteristics, vegetation and climate; and an assessment of the scale and impact of the landmine problem on the individual, community and country". These two elements of a national survey (recording the mine and UXO hazards and assessing the impact) are interdependent, although in some situations it is not possible to collect both categories of information concurrently

A ***technical survey*** is defined as "the detailed topographical and technical investigation of known or suspected mined areas identified during the planning phase. Such areas may have been identified during a national survey or have been otherwise reported The primary aim of a technical survey is to collect sufficient information to enable the clearance requirement to be more accurately defined. and for the subsequent clearance operation to be conducted in a safe, effective and efficient manner".

IMAS replaces the concept of a "level 3 survey" by providing general guidance on the type of information required on completion of the task. This should include details of the cleared area(s) — as proposed in the original "level 3 survey" But it should also include *inter alia* details of the clearance organisation, procedures and equipment used to clear the area, details of the quality assurance conducted and post-clearance inspections, details of reduced and cancelled area(s), and details of any incidents and accidents.

Although not addressed in IMAS, the concept of a "level 4 survey " has been suggested as a means of confirming whether land is being used after clearance as envisaged. Such a survey would represent a logical final stage in the process of identifying and assessing the scale of the hazard and its impact, planning for the removal of the hazard, removing the hazard, and finally confirming that the impact has been removed — or at least reduced

The scope and significance of the Landmine Impact Survey

Several Landmine Impact Surveys are currently being undertaken within the Global Landmine Survey process being managed by the SAC The survey in Yemen was completed in summer 2000, and at the same time surveys were ongoing in Cambodia, Chad, Mozambique and Thailand. In a format adapted to the emergency conditions, a modified impact survey was done in Kosovo in winter 1999/2000.

The scope of the Landmine Impact Survey is deliberately limited. One of the essential objectives of the survey is to provide a ranking of communities by severity of mine impact that can inform the allocation of mine action resources. Indicators are used, and are combined in an index — the Mine Impact Score — to create the ranking. For that purpose, the Survey records types of problems that the mines have created for a community. It does not go deeply into measuring the numeric extent or degree of those problems.

Indeed, the value of the survey information must swiftly be addressed Surveys are expensive, yet it is still rare that questions are asked about the value of the returned information, or about how design interventions might affect validity and reliability of surveys, and thereby their value.

A recent computer simulation undertaken by the SAC of the informational value of the Landmine Impact Survey using the Mine Impact Score that is its core (see below page 28ff.) explored this precarious terrain. In a hypothetical world populated with mined communities, two utility variables were evaluated against different information scenarios. These dependent variables were:

- 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; and
- 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 was voted for the total effort of demining in all scenarios. Communities were assigned for priority demining using these four criteria.

- A *random-sequence scenario*, using no prior knowledge about the communities, it picked them in a random order from the list and continued demining until exhausting the budget.
- A *minimal-knowledge scenario*, using the government census as prior information; it assigned communities by decreasing population size, on the assumption that mine hazards and road-demining benefits were positively correlated with population. It had the same budget limit as above.
- The *Landmine Impact Survey scenario* selected communities starting with those with the highest impact score It had the same budget limit.
- The *perfect-knowledge scenario* was the baseline. It used the entire knowledge simulated into the data set.

However, since no monetary value of saved lives was permitted, the last scenario had to choose between a maximum economic benefit and a maximum accident reduction strategy. Both are possible; here we explore the economic strategy because it (imperfectly) emulates what a decision-maker with additional Technical Survey information (the closest to being omniscient!) could do. In other words, this scenario assigns communities by descending present value of demining.

The budget for these scenarios was 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 was that communities are either completely demined, or not at all.

Only demining was considered among the repertory of mine action activities. The economics was limited to physical capital; the cost and benefits of victim care, rehabilitation, and of secondary effects on families were 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 summarised 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 Landmine Impact Survey portfolio is strongly drawn to communities with comparatively many recent victims It has a low preference for communities with high economic benefits from demining. The reason is that the Landmine 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 Landmine Impact

Scenario	Communities demined	Cost of demining (US$)	Returns from demining (US$)	Net benefit (US$)	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
Landmine 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

Survey portfolio in economic benefits There are sample fluctuations in this scenario, of course, but it also did better in a second run. 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 Landmine Impact Survey-based portfolio does better in accident reduction than a purely economic benefit maximising strategy. By implication, it does more poorly on the economic side
- 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, there need to be bridging elements between the Landmine Impact Survey and a cost-benefit analysis of demining particular physical assets in the affected communities. 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 Landmine Impact Survey, if one looks only at the Mine Impact Score using current definitions, has value for the qualitative, compassionate, and victim-related mobilisation 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. More analysis is needed of the inferential potential of the survey data, and this will be facilitated when the correlations among indicators become empirically known from the first country surveys 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

Of course, the purview of the Landmine 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 Landmine Impact Surveys to change will follow obvious professional lines:

- The demining community, staffed largely by ex-military personnel, will press for more Technical Survey elements to be included, enriching the Landmine Impact Survey with technical data. 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 data collection in Thailand, prompted by the close co-operation between the foreign NGO and the national mine action centre, an organisation of the armed forces.
- The social and medical professions, concerned with victim assistance, may find systematic gaps, such as on the victims of older date, and will want to see the data collection formats changed to their needs.
- On the donors' side, the concern with the impact of the mine action projects will call for economic analyses, such as cost-benefit analyses, and thereby exert pressure for the adoption of stronger metrics.[1]

The Mine Impact Score as a compassionate measure

The Mine Impact Score is the central element of the landmine survey design While its basic function — to permit a priority ordering of communities — is easy to understand, its technicalities may defy quick comprehension.

Technicalities

The Mine 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 come to harm 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,
- The types of livelihood and institutional areas to which mines are blocking access, and,
- The number of recent victims.

Technically, the score is a linear combination of two contamination variables (presence of mines, presence of UXO), 10 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 natural number counted over the past 24 months, not the truth value of the assertion that there had been some victims in that period. The coefficients are the weights that users can set in response to their preoccupations and country conditions; the Survey Working Group, chaired by the SAC, that oversees the Global Landmine Survey process 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).

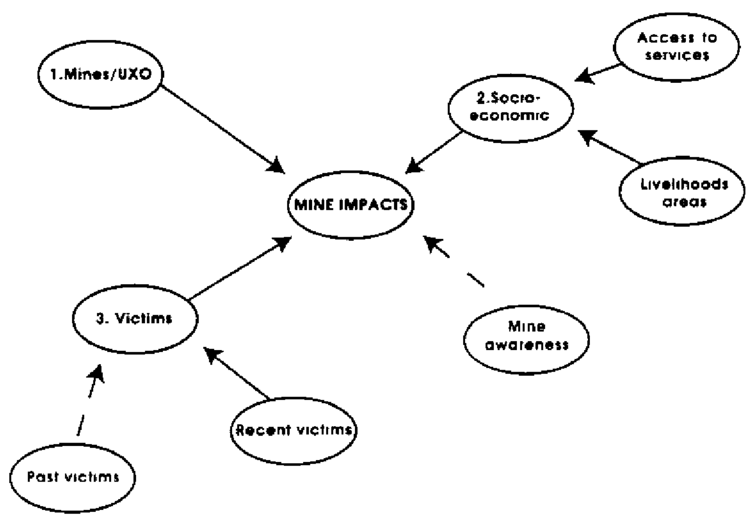
The 13 arguments of the score are composite truth values of qualitative statements, and the number of victims, over all mined areas in the community Some of them are truth values of indicators that are themselves composite statements from several more specific indicators. For example, "Some infrastructure 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-

[1] A metric is the set of technical instructions of how to measure a concept, condensed to a variable with permissible range of values, defined unit and dimension.

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).

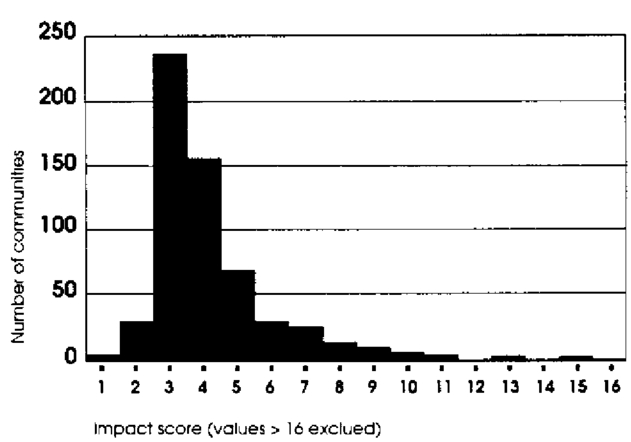
Figure 1 is an influence diagram of the concept of mine impact as used in the Landmine Impact Survey. Data on contamination, recent victims, as well as on livelihood and institutional blockages, is factored into the impact score. Some data is collected on victims of less recent date and on mine awareness education, but it does not influence the computation of the score.

Figure 1: Influence Diagram for the Mine Impact Concept Used in the Landmine Impact Survey



As an example of an actual result, Figure 2 displays the distribution of impact scores of the 592 affected communities surveyed in Yemen.

Figure 2: 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 Mine Impact Score is a composite index, and the indicators that form part of it were first chosen 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, at worst suspicious of, the way the indicators have been "hard-wired" into the Information Management System for Mine Action (IMSMA)[2] 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 natural numbers is trivial, but may despair of understanding the remainder of the score's components.

They may be helped with an analogy: the relationship between a text and the alphabet. Suppose, for a moment, that the key community informants were using a special language for the accounts of the local mine problems they give the survey staff. 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 "I". 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 neighbourhood by neighbourhood, 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 larger the alphabet.

What every student of the Landmine 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, as several critics have pointed out. If, for example, a farmer finds one mine in a corner of his orchard yet is still perfectly able to harvest the other 95 per cent of his fruit trees, his discovery will make 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 way too sensitive at the low-intensity end of mine infestation, and is very dull at the high end. It is not well calibrated

Two considerations attenuate for the absence of proper calibration. First, within the limits of efficient and reliable data collection during most Landmine Impact Surveys, there is no way to define meaningful units for the occurrence of mine effects other than persons hurt An exception may be made for fairly homogenous societies with long-standing mine action programmes, such as irrigation-based rural Cambodia, where data on inaccessible farm area may be readily available. In general,

[2] The IMSMA is a sophisticated GIS-based database that has been developed by the GICHD on behalf of the United Nations

however, the information economics of the Landmine Impact Survey will forbid stronger metrics

Second, societies learn. The hazard from mined cropland, to stay with our example, is not simply the static product of the number of people who depend on farming and of the square metres 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 probably be less than proportionate to their actual areas, and more to, say, their square root or to any other of the power functions common in learning models.

In other words, the Mine 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 Landmine 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 Mine Impact Score, however imperfect, illustrates how such a calculus can be implemented. Nor does the Landmine 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). Figure 3 (page 32) offers an illustration of how enumerators collect data in the field for the Mine Impact Score.

Compassion

This discussion so far has been technical. Given that the Mine Impact Score takes more than 10 substantively different arguments, this is understandable. But the technicalities are less important than the basic intent of the impact score, which is to arouse and inform human compassion. The impact score signals those communities which have, by several standards, suffered greatly from mines and 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 actuality and future potential is, of course, not unique to the Mine Impact Score, and is key to the functioning of a number of organised 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. First, 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 Landmine 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.

Figure 3: An Intuitive Approach to the Mine Impact Score

Some readers may find it easier to understand the score when they look over the shoulders of enumerators who do the actual figuring 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 to add	Score
The community reported that				
• there were mines.	If so, give	2 points	____	
• there was UXO	If so, give	1 point	____	
		Subtotal for explosives realm:		____
• 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 points		
			Subtotal for socio-economic realm	____
• there were ____ mine victims in the last 24 months.	Multiply with 2 points for victims		____	
		Points for victims		____
		Total mine 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 6 and 10, the impact is considered to be "medium".
If the score is higher than 10, the impact is considered "high". ____

Impact ranking: ____

Secondly, they need to be able to portray history as a kind of living present into which future actions and outcomes can be integrated. At a deeper philosophical level, it is probably this factor which, more than others, bred disappointment with the old generation of general mine surveys, prior to the socio-economic perspective What is unique to 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 Mine 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 may have known few victims for considerable time, simply because previous accidents due to intense movements discerned danger areas precisely. 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 Landmine 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 palpably afflicted individuals. Philosophically, an individual-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 characterised in terms of social status than by inclusion in a community with a summary impact score.

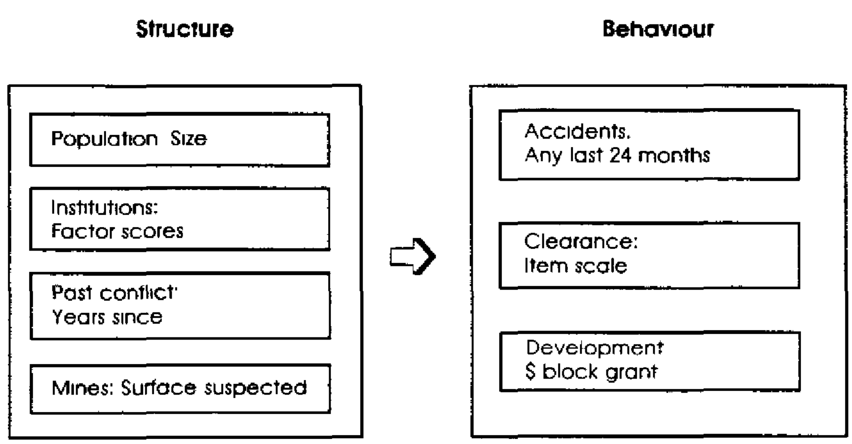
There are several reasons why a community-based description and analysis should be pursued. Most powerfully, the mine action community depends on estimates of the affected population. At the required level of aggregation, it is difficult to see how this figure could be established other than as the population 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 actors who solve problems of individuals living with mines. 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 Landmine Impact Survey.

Moreover, the relationships that exist between the community characteristics and behaviours toward landmines form a background on which it may be easier to validate the Mine 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?

Figure 4 exemplifies a possible "structure drives behaviour" model. In each box, concepts are not complete, but some are given as examples, together with a possible metric. Note that the Mine 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.

Figure 4: A Model of Structure and Behaviour 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 centre of community Years since mines last laid Distance to nearest (other) community with some recent mine victims
Institutional endowment:	Degree of institutional modernisation Degree of technical modernisation

"Distance of nearest mined area to centre of community" was discarded because it was difficult to interpret in the case of dispersed village communities. "Years since mines last laid", too was left out in order to reduce the number of variables in the regression model. The two institutional modernisation variables are ex-post interpretations of a factor pattern.

Of further note is the fact that 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 centre 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 (See below: *The Institutional Endowment of Mine-Affected Communities*)

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 equally strong on both factors. It is shown under the institutional factors for mere conventional reasons

The results regarding recent accidents and numbers of victims are fascinating:

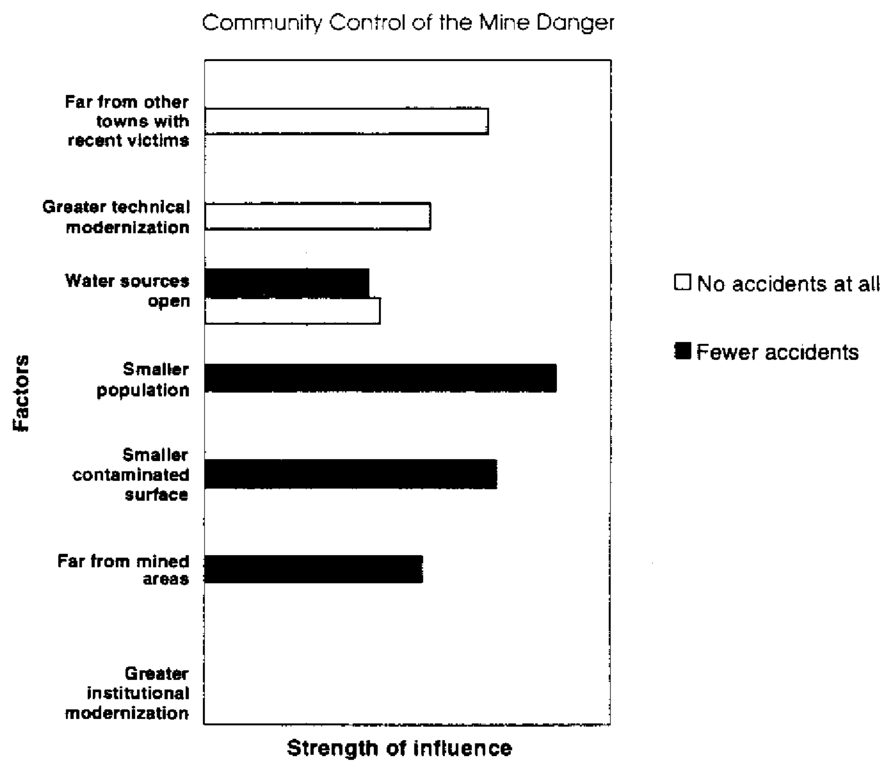
- Mine-affected communities are subject to two distinct regimes. One set of factors determines whether a community has any mine accidents at all. A different set of factors determines, for communities that do suffer accidents, whether they have more or fewer victims Blocked access to water is a common factor of both regimes.
- The strongest influence for being totally accident-free 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 technical modernisation factor and the access to water bodies come second and third in the power to avoid accidents.
- In communities that do have mine accidents, the size of population, the contaminated surface, and the distance to the nearest mined area are all positively associated with the number of victims
- However, this is far less disturbing than the finding that the degree of institutional modernity is of influence neither for being without accidents at all nor for the number of victims 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.

Figure 5 visualises the proportional influence of these factors for each regime total avoidance of accidents, and number of victims.

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 two-year period (Figure 6) and of the Mine Impact Score are both heavily left-skewed, in spite of the fact that the two measures are largely independent of each other. This would lend credence to the validity of the Mine Impact Score as a realistic measure of the harm reduction potential.

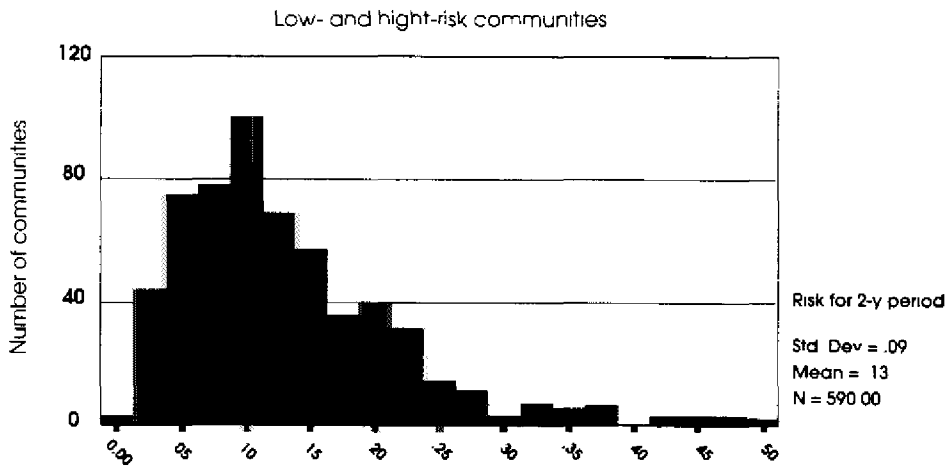
Figure 5: Strength of Community and Conflict Background Variables, Yemen



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 has done in his life-long study of small communities; 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 Landmine 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 co-operation and programme 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'Brien on outside network influences (1991) and Zekeri (Zekeri et al., 1994) on the connection of past

Figure 6: Probabilities for Communities to Have Mine Accidents[3]



history and development efforts. The latter works with confirmatory factor models that should be explored for models of mine-affected community behaviour and for indicator design to supply the relevant data.

Non-communities: The "work-around" in Kosovo

Communities as social groups capable of self-description are key to the Landmine Impact Survey methodology. But they are not available in all situations. In Kosovo, immediately after the return of the refugees in mid-1999, foreign military and relief organisations knew more about landmine and UXO contamination than did the population of Kosovo. Also, many returnees and other citizens stayed in temporary quarters away from their former communities. Truly knowledgeable local key informants were rare

Essentially, 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, these were over 300 units known as districts.

As a result, the analysis that served mine action priority setting relied heavily on spatial constructs. Priority rankings were worked out for two kinds of entity:

- Suspected areas for area reduction and clearance, and
- Districts for mine awareness education.

[3] Based on a logistic regression model

The metrics used were stronger than those of the Mine Impact Score in a normal Landmine Impact Survey. For the classification of districts, the percentage of contaminated land was used. For the suspected areas, the score used 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 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 worked in. No emanation from the post-conflict society influenced the data and the analysis, except for awareness education sites, accident locations, incomplete district population updates, and post-return incident and suspected area reports. Notably, no systematic and useful data on types of mine impacts was available other than those inferred from distance to settlements and roads, and from land use.

Initially, the data on suspected areas and on accident locations was of modest reliability, but this improved with the increasing visits made by organisations in different branches of mine action to the communities These improvements were not accompanied by significant acquisition of social data, 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 of providing decision tools for mine action, and it did so within useful time, creatively exploiting a limited gamut of data. Some of the spatially defined data, such as land use, was ready only after several months of astute inter-agency diplomacy. During the same period, other data would slowly improve in reliability and completeness.

The point is, however, that despite stronger metrics to begin with, and improved reliability over time, very 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 harness enough knowledge from the affected populations themselves.

That was not a major problem in Kosovo, where mine action resources were plentiful to reprioritise specific interventions when new information became available (such as about communities with fresh accidents). Similar situations, however, can occur elsewhere As in Kosovo, 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 readily manageable scenario arises when mined areas are very large, with each of them able to 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. Such 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 logic for this has not yet been created.

Concluding remarks

The Landmine 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, too, is 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.

The core logic of the Landmine Impact Survey, and the one "hard-wired" into the database, uses a weak metric to assess degrees of mine problem severity The weak metric is part of the price paid for a community-centred approach. It allows the calculation of a Mine 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 threaten 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 Landmine Impact Survey are perfectly conceivable. Whatever their logic and metrics, the fundamental challenges will remain similar. There is painfully little valid theory around of the behaviour of mine-affected communities on 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.