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Integration of Different Data Bodies for Humanitarian Decision Support: An Example from Mine Action

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Geographic information systems (GIS) are increasingly used for integrating data from different sources and substantive areas, including in humanitarian action. The challenges of integration are particularly well illustrated by humanitarian mine action. The informational requirements of mine action are expensive, with socio-economic impact surveys costing over US$1.5 million per country, and are feeding a continuous debate on the merits of considering more factors or 'keeping it simple'. National census offices could, in theory, contribute relevant data, but in practice surveys have rarely overcome institutional obstacles to external data acquisition.

A positive exception occurred in Lebanon, where the landmine impact survey had access to agricultural census data. The challenges, costs and benefits of this data integration exercise are analysed in a detailed case study. The benefits are considerable, but so are the costs, particularly the hidden ones. The Lebanon experience prompts some wider reflections. In the humanitarian community, data integration has been fostered not only by the diffusion of GIS technology, but also by institutional changes such as the creation of UN-led Humanitarian Information Centres. There is a question whether the analytic capacity is in step with aggressive data acquisition. Humanitarian action may yet have to build the kind of strong analytic tradition that public health and poverty alleviation have accomplished.

Keywords: mines, humanitarian mine action, geographic information systems (GIS), data acquisition, Humanitarian Information Centres.

Introduction

A recent article in this journal (Kaiser et al., 2003) highlights the capacity for geographic information systems (GIS) to link data from various sources that are of

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concern to responders to humanitarian emergencies and thereby help improve the quality of decision-making. An example of practical data and programme integration is provided from the 1999–2000 Ethiopian famine, where decision-makers used overlaying maps combining food distribution and nutrition survey results (Spiegel et al., 2000). Tanser and le Sueur (2002) review GIS applications to public health problems in Africa, most of them in non-emergency settings. Despite the more tranquil environments, one comes away with the impression that applications that truly integrate data from different sources and sectors are as rare as in humanitarian action. While 'many issues of poverty relate to large-scale problems requiring integration of large spatial datasets' (ibid., 7), the authors acknowledge high cost and high levels of required expertise as deterrents to the wider use of GIS technology. Obviously, the balance between cost and the value added of more and more diverse information is a concern in spatially targeted interventions, in both emergency and other settings.

This article offers a case study of some of those issues from one humanitarian sector: mine action. Humanitarian mine action is particularly suitable to illustrate such integration issues. On one side, it may well be the sector within humanitarian action that has built the most cogent and internationally recognised data model of that segment of reality which concerns its practitioners. The Information Management System for Mine Action (IMSMA), developed at the Technical University of Zurich, Switzerland, is the sector information management tool recommended by the UN (UN Mine Action Service (UNMAS), 2003), enjoys de-facto recognition as an international standard and is tightly integrated with a GIS application. This consensus situation contrasts with the diversity of frameworks admitted in other humanitarian sectors such as food security (Jaspars and Shoham, 2002).

On the other side, information behaviour in humanitarian mine action is increasingly rationalised in the light of funding and intersectoral concerns. This $240-million-a-year global industry seems to have reached a funding plateau (ICBL, 2002) that brings out issues of competition and collaboration more sharply. A trickle of cost-benefit studies into mine clearance has appeared (Harris, 2000, challenged by Paterson, 2001; Harris, 2002; Byrd and Gildestad, 2002). Cost-saving alternatives to mine clearance, where appropriate, are being discussed (van de Merwe, 2002). Such decisions, however, call for broader informational bases. Barlow (2003) summarises the mood of a recent mine action programme managers' meeting:

> Other types of data will deal with economic factors including land use, commerce, trade, markets and distribution of goods. Some necessary information will deal with societal considerations such as education, gender roles, and customs, while other phases of strategic planning will require information relative to other supporting agencies and organizations involved in work in the region. In other words, the need for accessing and properly using information becomes more critical as the necessity of strategic planning becomes more evident.

This sort of spiralling complexity, however, raises fears of inefficiency and of difficult links with external authorities who do not understand the landmine issue, and leads to calls to 'keep it simple' (ibid.). In other words, while the management of standard information from within the sector is no longer an issue, there are no recognised stopping rules in the search for information that will enhance mine action decision-making with considerations from other sectors. The point of this article is that integrating data from other sources and sectors can indeed produce valuable new insights for policy and decision support. Both the production and the use of such knowledge entail costs before they yield gains, and if the value added is negative or very uncertain, it should indeed be kept simple.

Plan of the paper

The Global Landmine Survey is briefly described as the current sector response to demands for socio-economically based action priorities, and the landmine situation in Lebanon is summarised as apparent from a recent impact survey following this format. Used in isolation, the survey data seem to confirm the claim that landmines in Lebanon created 'a lack of land for agriculture' (Ahmed, 2001). This claim, made by mine-action coordinators — Ahmed worked for the coordination centre for southern Lebanon — as well as by many community key informants interviewed by survey workers, is one of the premises for programmes that have cleared large tracts of contaminated land, most of it by commercial firms.

When combined with agricultural census data, the survey produces a qualified tableau of the reality of affected communities — one that may recommend less clearance and more infrastructure investment if there is a choice. There is a description of the segment of the census data used for this exercise and the GIS operations needed to make it conform to the different format of the community survey data. Reference is made to a model of the influence that landmine impacts and years since the end of hostilities have on agricultural land use, presenting select statistics in an appendix. The results are open to the interpretation that the major problem of landmine-affected communities in Lebanon is not blocked farmland, but the fact that many of them belonged to regions of long-standing hostilities that delayed their transition into service-oriented local economies or to more capital-intensive forms of agriculture.

While the analysis of integrated data sets can produce fresh insights, integrated models necessitate auxiliary assumptions. Some of these are spelled out in order to demonstrate the additional uncertainty as one of the possible downsides of data integration. Moreover, the acquisition of outside data, their processing and the dissemination of new results entail costs. Some of the hidden costs for mine action are described. The difficult-to-evaluate balance between costs and benefits leads to some concluding reflections on data integration and analysis in wider humanitarian action.

The case study

The Global Landmine Survey

Within humanitarian mine action, progress in integrating information is manifest chiefly by the way the traditional array of survey activities have been reformed. Following the 1997 Ottawa treaty to ban anti-personnel mines, several mine-action NGOs and the UNMAS launched the Global Landmine Survey, a multi-country survey project. This initiative has helped to institutionalise the collection of social and economic data, along with contaminated area data, to enhance the overall management of mine-action programmes worldwide, and in that sense has achieved a paradigm change over the erstwhile purely technical approach to mine clearance.[1]

Socio-economic impact surveys have since been completed in several countries and have been certified by the UN. More are ongoing or being planned. In addition to establishing countrywide inventories of communities affected by landmines and/or unexploded ordnance (UXO), the surveys classify communities by the severity of socio-economic impacts. The classification relies on an internationally standardised scoring system that combines, for each affected community, types of munitions, blocked resources as well as recent victims, using weights that national stakeholders may adjust within limits. Technical information at the contaminated-area level and demographic data on incident survivors is also generated and is available to national mine action coordinators through the IMSMA look-up, mapping and reporting facilities. One key outcome is the designation of a small segment among the identified affected communities (usually 10–20 per cent) as high-impact communities deserving priority attention for technical surveys, clearance, victim assistance and mine-risk education.

This information does not come cheap. The impact surveys of Yemen, Chad and Thailand, for example, each cost between $1.5 and 2 million. This expense is justified with the gains from more judicious clearance decisions, the effect on donor mobilisation and the value of the equipment and skills that the survey implementers leave with national mine-action organisations. As one observer of the Yemen survey quipped: 'So, you identified 14 high-impact and 84 medium-impact communities [out of 592 that the survey detected]. Was it worth the money?' Not surprisingly, then, ideas are traded from time to time to make cost savings by substituting existing mine survey information for part of the new impact survey requirements (a concept known as 'retrofitting') or to enhance the value of the impact survey by supplementing it with existing external data bodies.

The impact survey in Lebanon, conducted by the British charity Mines Advisory Group in collaboration with the Lebanese National Demining Office between March 2002 and August 2003, went one step farther in the latter direction. Beside its own data, it used a segment of the national agricultural census data.

This for the first time has allowed for some systematic, although limited, comparison between affected and non-affected communities. The normal impact survey format, while sampling unsuspected communities for false negatives, does not collect substantive information on non-affected ones, and rather focuses on a full census of affected communities. This has made it difficult to put landmine impact findings in perspective with other issues of reconstruction and development. The further a country finds itself from past conflict, the more critical the inclusion of other substantive data sets because communities have had time to adapt to the contamination.

However, such an ambition was beyond the original intent and design of the Global Landmine Survey, limited, as it was, by financial and design consensus concerns. The extended scope of the Lebanon survey has come as a windfall opportunity when additional data were made available at no extra direct cost.

The landmine situation in Lebanon

Landmines were used extensively in Lebanon's 25-year history of armed conflict; in addition many areas remain polluted with unexploded ordnance (UXO) (Wie, 2002; Ahmed, 2001). The impact survey identified 306 affected communities in five out of six provinces; only the sixth province, Beirut, has been completely cleared. An estimated 1,087,000 people live in the affected communities; however, particularly in the large suburban communities of Mount Lebanon, just outside Beirut province, only a fraction of the residents are exposed to the hazard. During the two years before the survey, mine and UXO incidents had happened in 54 of the affected communities, killing 11 and injuring 97. At an estimated 9.9 new victims per year per 100,000 people living inside contaminated communities (Spurway et al., 2003), the hazard for those at risk is at similar level to Yemen (10.8), but considerably lower than, say, Thailand (34.5) and Chad (59.5). However, victim rates are distributed very unequally across provinces, with the southern provinces and the Bekaa suffering rates several times those reported for the north and Mount Lebanon.

The survey also identified 980 distinct areas of suspected landmine or UXO contamination.[2] Despite the largely urban and service-sector character of the Lebanese economy, most of the affected communities complained of blockages of some of their farmland and pasture. Blocked public infrastructure or residential areas were reported only by a small minority of communities, reflecting the fact that most of the remaining contamination is outside built-up areas. Using the standard impact scoring method and a set of weights approved by the National Demining Office, the impact survey classified 114 (37 per cent) of the 306 affected communities as low-impact communities, 164 (54 per cent) as medium impact and 28 communities (9 per cent) as high impact.

In May 2000, the Israeli army withdrew from southern Lebanon. Vigorous clearance has since taken place in the formerly occupied area under a programme known as Operations Emirates Solidarity, for which the UN, the National Demining Office and the United Arab Emirates operate a joint coordination centre in Tyre. By June 2003, most affected communities between the Litani River and the so-called Blue Line, which runs along the southern border, had been cleared. The impact survey revealed a number of problems that are preventing land from being returned to productive uses — most commonly lack of capital to redevelop the land and the paucity of access roads, water and power supplies.

Lebanese agriculture

These obstacles to economic rehabilitation tie in with general conditions of Lebanese agriculture. The war did tremendous damage to this sector. Many of the irrigation systems, storage facilities, farm buildings and roads were either destroyed or gravely neglected, and vast agricultural areas were abandoned. Particularly in the south, the war uprooted entire communities. As they resurfaced to peaceful conditions, farmers found their incomes eroded between high production costs and competition from cheap produce imported from Syria, Jordan and Egypt. Many left farming. The agricultural environment is one of the reasons why the 'government's attempts to return wartime internally displaced people to their villages have largely failed' (Mekdachi, 2001: 26). On the other side, recent years have seen large-scale investment in milk production and the rapid growth of high-value products like strawberries, watermelon and exotic fruits.

The 1999 agricultural census

In order to improve the informational basis of its agricultural-sector policies, the government of Lebanon, with help from the UN Food and Agriculture Organization, conducted a census in 1999. Data were collected on a variety of aspects of 194,829 farming entities for the farming year 1997/8. FAO also assisted with spatial data-management tools (Latham, 2000) resulting in a census database which is, at least in part, geo-referenced.

At the request of the National Demining Office, the Agricultural Census Office shared land-use data on 1,633 census tracts with the Mines Advisory Group to support the impact survey analysis. Quantities of interest include actively farmed land (251,721 hectares total), irrigated land (as part of the actively used land; 105,381ha) and abandoned land (54,015ha).[3] The census defined abandoned land as parcels that had lain fallow for five years prior to the census interview. For comparison, the 980 suspected areas recorded by the impact survey cover an estimated 13,748ha (experience with technical surveys suggests that the actually contaminated area will be much smaller, but for the use or non-use of land, it is the social perception that matters).

Agricultural census information is used to form two important ratios.[4] First, the active land-use ratio. Taking active use as the converse to land abandonment, this ratio is defined as 1–abandoned land/(abandoned+actively used land). Its significance is as a proxy indicator for the economic viability of local farming. The assumption is that if farming can become more viable, then relatively less farm land will be abandoned.

Second, we use the irrigation ratio (=irrigated land/actively used land) as proxy for the capital intensity of farming. While not all forms of agricultural intensification lead to higher irrigation ratios — greenhouse farming is a counterexample in point — it is assumed that overall communities that succeed in deepening their agricultural capital intensity will also irrigate relatively more of their farm land.

These concepts are important because, first, land abandonment is shaped by market forces and is larger than the surfaces taken out by landmines and UXO. Second, a reversal from irrigated to rain-fed farming or even to pastoralism during the war years fits in with the hypothesis that war leads to shifts in economic activity towards forms which 'are relatively less sensitive or vulnerable to the disruptions caused by such strife' and, because they are less capital intensive, 'could be associated with a significant reduction in the growth potential' (Deininger, 2003: 14, who refers to a more general conjecture by Collier, 1999). In other words, these two ratios characterise the agro-economic environment of landmine-affected (and other) communities and ultimately determine the chances for cleared farmland to be returned to profitable use.

One other set of variables from the agricultural census is important for this analysis. The census assigns each tract to one of 12 agro-climatic zones following a typology created by a French geographer in the 1960s. These zones define the natural and traditional environments for particular forms of farming and types of crops.

Integrating the census data

These data do not immediately conform to the set of landmine-affected (306) and landmine-free (1,585) communities which together form the set of all communities (1,891) in the government gazette. Agricultural census tracts have known areas; in the GIS they are represented by polygons. Communities have known centre points; their GIS representations are point coordinates. Each community, therefore, is included in an agricultural census tract, at least in theory; each tract may contain zero, one or several community centre points. In practice, a one-to-one relationship exists for approximately half of all tracts and of all communities. Almost one-quarter of the tracts contain no community centre points. Table 1 details the inclusion frequency.

This leaves 1,831 communities whose centre points are within some agricultural census tracts. In order for these communities to inherit the agricultural information, a number of simplifying assumptions are needed. The first is that communities have land-use and irrigation ratios similar to those of the tracts that contain their centre points and that they belong to the same agro-climatic zones as the surrounding tracts. Since the degree of similarity cannot be estimated, the ratios are set for communities equal to those of their surrounding tracts. In tracts that embrace several community centre points, all member communities inherit the same ratios and the same agro-climatic zones.

Another auxiliary assumption is needed given the agricultural census reference period. It is assumed that land-use and irrigation ratios in 2003 are similar to those of the farming year 1997/8. This, clearly, is a strong assumption; the Israeli withdrawal took place between those years, and the political environment for Lebanese agriculture changed in part of the country very markedly.

The actual mapping of the agricultural tract values to the communities was done in the GIS application, using an operation known as a spatial join. This required one further geography-based operation requiring a simplifying assumption: the impact survey established the last year during which each landmine-affected community was exposed to hostilities, ranging from 1976 as the earliest return to peace, all the way to 2003 for some communities exposed to very recent shelling. The year of exiting the war is important because it defines the number of years that local communities have enjoyed economic and social growth unhampered by violence. For non-affected communities, the years are not known. Given the strong local clustering of

Table 1 Communities by agricultural census tracts

Communities per tract	*Agricultural census tracts*	*Communities*
1	881	881
2	264	528
3	74	222
4	20	80
5	7	35
6	2	12
7	4	28
8	2	16
14	1	14
15	1	15
Agri. census tract information missing		60
No community inside tract	377	
Total	1,633	1,891

communities with similar exit years, it can be assumed that non-affected communities returned to peace roughly at the same time as their landmine-affected neighbours. The exit year for non-affected communities can be set as the median exit year of all affected communities in their respective districts.

The schematic presented in Figure 1 (see page 296) graphically expresses some of the relationships between agricultural census tracts, districts and communities and the operations of assigning agricultural census tract and district variables to communities. They set the stage for the combined analysis.

Expected findings and new insights

The initial belief was that landmines indeed caused a lack of farm land, and more so in the southern regions that had exited the war late, the anticipated result was that more severe landmine impacts and shorter recovery periods (i.e. later exit from war) would both work to depress agricultural ratios. These negative effects were expected on active land use (proxy for the viability of local agriculture) as well as on irrigation (proxy for capital intensity and growth potential).

As expected, higher landmine impacts tend to depress both active farm land use and irrigation intensity. However, they do so at a statistically significant level only for the question of whether a community should be at very high levels of land use and irrigation or not. In other words, once a community is using its farm land and irrigating it below very high levels, landmine impact no longer has a statistically significant effect of depressing agricultural ratios any further. Landmines must be particularly badly interfering with the local farm economy in communities that, if unaffected, would be predisposed (for example, by their agro-climatic setting) to use farm land and irrigation to very high levels. Ahmed's observation that landmines created a lack of farm land (see page 290) is not tenable as an across-the-board claim.

By contrast, the year in which the local community exited the war wields consistent influence on the ratios of interest. Communities which exited earlier, and thus enjoyed longer recovery periods, tend to irrigate more of their farm land. That is common sense and is expected also under the Collier-Deininger hypothesis (see page 293) that longer strife promotes less capital-intensive production.

The real surprise is in the effect that exit from war has on active farm land use. Contrary to all expectation, and across all levels, communities that exited the war late tend to be at higher active land-use levels. The causal mechanism can only be conjectured: the communities in the south that were in the conflict zone until the Israeli withdrawal in 2000 have had less time to participate in the transition from an agricultural to a service-dominated economy. Their residents, for lack of investment and jobs, may have remained stuck in low-income farming livelihoods. If correct, this interpretation would also imply that obstacles other than landmines are more important in the context of recovery and growth. What these obstacles are, these data do not tell us, but more investment in landmine clearance in communities that came out of hostilities recently may not remove them since they already tend to use more of their land while irrigating less of it.

It is now time to return from this illustration of substantive findings to the methodological intent of this article, which is about the integration of data from different sources.

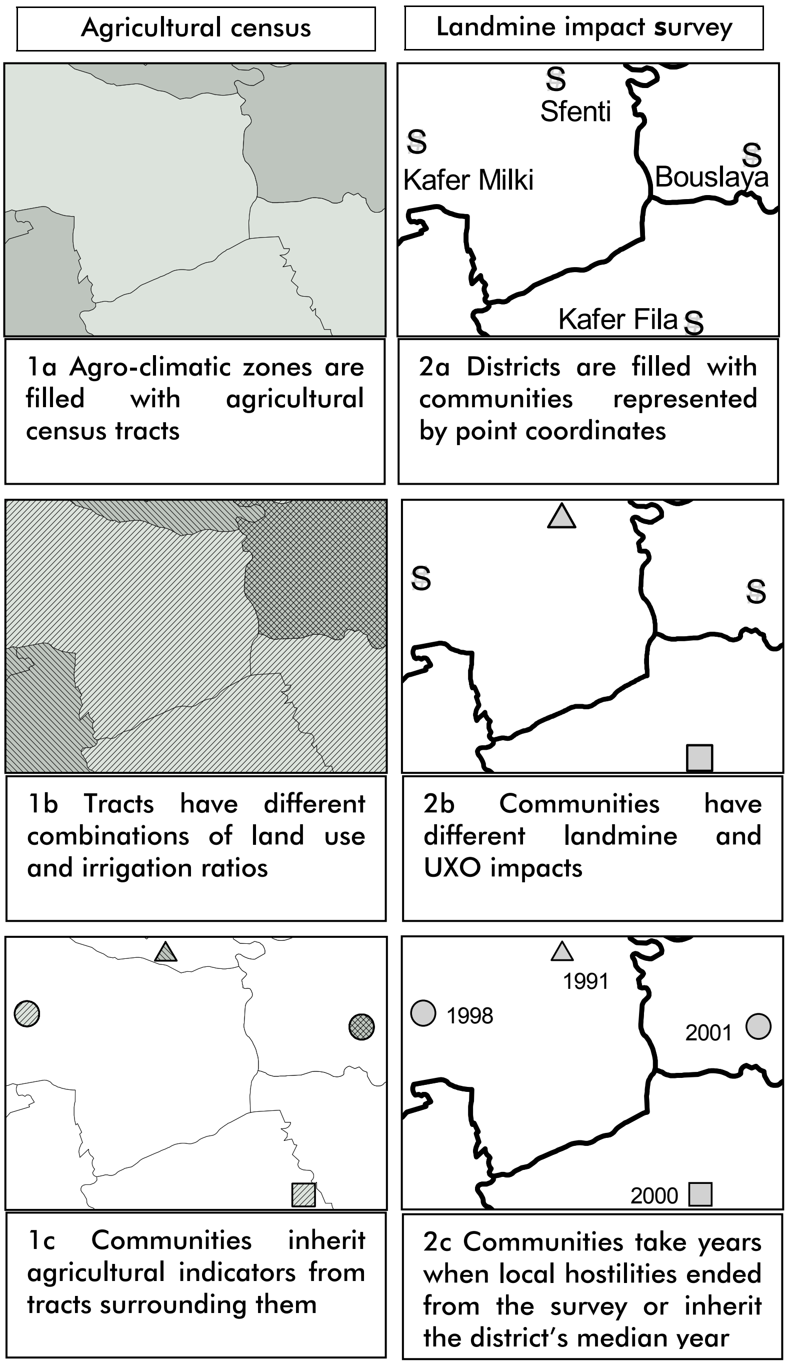

Figure 1 Relationships among census tracts, districts and communities

Costs and benefits for mine action

Comparison with non-affected communities

The inclusion of agricultural census data achieved two benefits beyond the normal brief of a country landmine impact survey.

For the first time, some substantive comparison is made between landmine-affected and landmine-free communities. Previous surveys were able to contrast affected and non-affected communities only by geographic location; in other words, they identified clusters of affected communities and, conversely, clusters of non-affected ones about which mine-action practitioners would not have to worry. By including non-affected communities, the analysis of landmine problems can be placed in a larger reconstruction and development perspective.

Detection of latent structures

The use of models integrating data from different sources also facilitates the discovery of latent structures and of unexpected connections that may take us beyond 'mine action as we know it'. For example, 'active land use' and 'irrigation intensity', imported from the agricultural census, are concepts that point also to the future uses of contaminated land that has been cleared or awaits clearance. Chances for profitable uses are determined by factors that are hardly measurable within the traditional, self-contained landmine impact survey.

Not every significant variable that integrated models identify can be translated directly into a policy variable. For example, it is known that the local agricultural environment determines whether cleared land will go back to active cropping, but one cannot simply plug into some equation the values of a local community and venture a forecast concerning the local clearance effects. What the discovery of such factors means is that in local assessments they should be carefully investigated and considered in the practical decisions.

Against those achievements, costs have to be taken into account. They are of three kinds, and each can be considerable.

The hidden cost of acquiring outside data

The search for relevant external socio-economic data bodies was arduous, in Lebanon as much as in other countries with landmine impact surveys. It absorbed a small, but not negligible part of the survey management's time. Worse, it introduced uncertainty as to which data can realistically be expected in useful time, how far to push negotiations with apparent holders of relevant data and what to gain for the landmine survey users if these data are obtained. In the case of the Lebanon survey, data-rich organisations were approached in several fields. Only the agricultural census offices responded positively, and only late, and only because the Ministry of Defence request carried weight with the Ministry of Agriculture.

The experience of other landmine impact surveys has been similar, with some positive exceptions. In countries with authoritarian polities or self-assertive bureaucracies, the administrative culture generally discourages and obstructs data sharing. International and donor organisations are sometimes complicit in this by neglecting to stipulate in their contracts that consultancy firms must share data with legitimate interested parties, let alone to keep digital copies in their own computers. Access to outside data is easier in two types of other situations: in very poor countries, and in the wake of military interventions. In Yemen and Chad, the community of researchers and of GIS users was small; moreover, both expatriate and national staff of the impact surveys used their closely-knit informal networks to obtain potentially useful data sets. In Kosovo, data bartering between the mine-action coordination centre, other UN offices, NATO units and consultancy firms was brisk; the mine-action information managers had a strong hand because others had a safety incentive in cultivating them. Some humanitarian information managers would agree that in the transition from Kosovo to Afghanistan to Iraq, Western armed forces have grown more forthcoming about sharing data, including geo-referenced data, as indexed by the shrinking delays in making bombing imprint data available.

These institutional factors are not merely tangential to data-integration concerns in humanitarian decision-making. They shorten or lengthen the windows during which producers of information bases can usefully search for, acquire, process and disseminate the implications of, external data. As such, they critically interact with the second and third kinds of hidden costs.

Strain to stakeholder consensus

The introduction of new perspectives in organisational fields that are already saddled with conflictual relations may erode existing consensus further. For Lebanon's mine-action stakeholders, the authors prepared a map of different agricultural vibrancy zones, based on these census data, and overlaid it with mine-affected communities. This was well received during two presentations in May 2003, but the same meetings became embroiled in acrimony over victim-assistance statistics that distracted from deliberating possible implications of the agricultural data for landmine clearance. In August, however, the director of the National Demining Office showed one of the team a map of demining work under way all along the area designated for a major irrigation pipeline in the south (Spurway, 2003). This indicates that clearance efforts are being focused more strongly on areas critical to the rehabilitation of major infrastructure rather than on universal clearance of farm land and pasture, much of which may not be returned to profitable use without additional outside support.

Weak social-science base

And third, it must be admitted that the social science used in humanitarian landmine action is still weak. Although the socio-economic impact scoring has been elevated to an international standard, validation studies are rudimentary. The community of practitioners is still digesting the change from a purely technical approach to mine clearance to the inclusion of socio-economic criteria for prioritisation. The IMSMA data model may be very advanced in data-management terms, but the connection between community variables and policy is tenuous. Cost-benefit studies have produced wildly divergent rates of return from clearance that forbid universal conclusions. Patently, the studies that have come out of this sector are trailing far behind the validity and depth for which epidemiologically inspired public health or econometrically tested development debates are noteworthy.

In this situation, surveys, studies and decision-support systems will not likely be welcomed when they expand their scope beyond consensus domains. Integration of outside data almost automatically involves some expansion of scope and perspectives, if only because the meaning of the added variables has to be assimilated. As the use of agricultural census data demonstrates, integration may depend on auxiliary assumptions, some of which may be questionable. Also, statistical procedures were used that are not intuitive for average information users in mine-action coordination centres. Fragile assumptions and exotic models feed the 'plague of uncertainties' (Bressers and Rosenbaum, 2000: 523) that bedevils policy and decision-making, and of which landmine-stricken countries like Lebanon have more than enough. Barlow's call to 'keep it simple' is relevant here.

Data integration in the wider field of humanitarian action

This study began from a reference to GIS applications in humanitarian emergencies. It then provided a case study of how data from different sources can be integrated in a GIS project and demonstrated that the analysis of an integrated data set can produce non-trivial results. However, GIS is not the only feasible integration platform. Other research programmes — for example, the UNDP and World Bank-driven Living Standards Measurement Surveys (LSMS; see, for many others, Grosh, 2000) as a tool for poverty-alleviation strategies — have developed their strengths in joining data from different points of time — panel survey analysis is their best workhorse. Spatial covariates may be used, but are not fundamental for this kind of research. In methodological research, however, convergences between spatial and temporal models are growing stronger (Elhorst, 2001; Anselin, 2001); and some of this is being translated into applied research, such as in nature conservation. Vance and Geoghegan (2002), for example, combine satellite imagery from a 12-year period with data from a later household survey. Their integrated model allows them to estimate the varying risk of forest destruction over time and the factors that determine it.

It is doubtful that humanitarian action can attain this level of data integration. The very nature of emergencies may militate against it. In backward view, emergencies disrupt institutional continuity, and previous information holdings may be lost or irrelevant. As a result, analysts and decision-makers may be limited mostly to cross-sectional data. In forward view, if the emergency is successfully resolved, humanitarian programmes fold or are transferred to different institutions, which may not be able or willing to maintain and update databases from the emergency period. During the emergency, many information needs are short-term and one-off, and call for look-up facilities and basic summaries rather than in-depth analysis. Security concerns, too, privilege the spatial perspective over the temporal — typically the 'where' of a threat is easier to assess than the 'when'.

Recent institutional changes are making the above less true. In regions of endemic complex emergencies, the international relief community has created centres with a mandate to collect and integrate basic data, again in a GIS framework. In all three recent Western military theatres — Kosovo, Afghanistan, Iraq — UN-led Humanitarian Information Centres supplied the relief community and the media with maps of diverse thematic content, and for Iraq a clearly proactive approach to humanitarian information management was taken.

However, in countries with persistent emergencies or those further advanced in post-war rehabilitation (such as Lebanon), the analytical demands on humanitarian information systems will grow. Maxwell and Watkins (2003) outline the logical components and linkages for such systems in complex emergencies. They detail seven requisite components, from baseline assessments to programme evaluation. It is an open question whether the needed analytical capacities are in step with the transfer of GIS technology and the aggressive acquisition of data. Even if only some of the components are meaningfully linked, the demands for data integration will be taxing.

This case study illustrates challenges, costs and benefits of such an exercise. Despite the relatively benign environment in which it took place, they were far from trivial. As in the practical applications reviewed by Kaiser et al. and Tanser et al. that were cited in the opening paragraph, GIS was the key technology. However, in order to harvest benefits from GIS-enabled data integration, tools were borrowed from other fields, chiefly from analytical statistics. GIS is a wonderful integration tool, but it does not by itself expose, let alone resolve, the fragility of underlying assumptions or institutional frameworks. Humanitarian information management still needs to build a research programme akin to those that gave wings to public health, poverty alleviation and nature conservation. If the prospects for this are bad, then it is better to keep it simple. If they are good, they may justify a long stretch of strenuous work ahead of this endeavour. Data integration challenges will be a big part of it.

Statistical appendix

The key models used on the integrated (impact survey plus agricultural census) data set are ordered logit regression ('ologit' in STATA, 2003) and ordinary two-outcome logit. Descriptive statistics for the two ratios of interest — the dependent variables — and for landmine impact scores and exit-from-war years and for the distribution of communities over the agro-climatic zones are not given here for space reasons. They are available from the authors, together with a more detailed model description and data table. The ordered logit models use four levels; the two-outcome logit models use the highest of the four versus all others. The levels are given in the a.m. model description.

Controlling for the natural environment, seven out of 12 agro-climatic zones are used as dichotomous variables. The union of the other five forms the reference category. This is necessary because of the way affected communities are distributed across the 12 zones.

The records are complete for just over 1,500 communities. The results are summarised in the following table. Coefficients and p-values are displayed. Confidence intervals and auxiliary quantities (constants, cut points) are left out for space reasons. P-values smaller than .10 are highlighted in grey (see Table 2).

Also, the regression models were run with a categorical specification of the time when communities exited from the war. This was in response to a suggestion that the period of conflict (and the nature of the local conflicts fought during particular periods of time) may be mor eimportant than the absolute number of years available for recovery after the local hostilities ceased. Three periods were formed, relying on natural break points in the histogram of exit-from-war years. The results (not shown here) indicate that time available for recovery is more important than the period effect.

Table 2 Regression results

	Active land use				Irrigation intensity			
	Four-level ologit		Highest level vs others logit		Four-level ologit		Highest level vs others logit	
N	1513		1513		1511		1511	
	Coef.	P-Value	Coef.	P-Value	Coef.	P-Value	Coef.	P-Value
Explanatory variables:								
Landmine impact score	-0.02	.224	-0.07	.007	-0.03	.117	-0.06	.030
Year conflict ended	0.04	.029	0.05	.012	-0.08	< .001	-0.08	< .001
Controls: Agro-climatic zones								
1. Coastal region	-0.26	.447	-0.47	.224	1.90	< .001	1.81	< .001
3. Northern olive zone	0.05	.881	-0.12	.740	-2.54	< .001	-3.68	< .001
4. Mount Lebanon and Jezzine	-2.37	< .001	-2.43	< .001	-0.20	.451	-0.13	.660
5. Oronte Aassi Valley	-1.70	.001	-1.74	.013	-0.96	.147	-0.83	.171
7. Hermon	-2.25	< .001	-2.11	< .001	-2.51	< .001	-2.10	< .001
8. South Plateau	-1.75	< .001	-1.87	< .001	-0.86	.012	-1.19	.010
9. Batroun and Chouf	-1.99	< .001	-2.08	< .001	-0.86	.001	-0.83	.009
Fit:								
Prob (_score = 0 & _year = 0)		.063		.004		< .0001		.0001
Pseudo-R2		.09		.13		.14		.19

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Notes

1. For a comparative perspective with other impact assessment approaches, see Harpviken et al., 2003.
2. For language economy, we will only use 'landmines' in the rest of this article even though impact surveys are about communities affected by 'landmines and/or UXO'.
3. These figures, calculated from data tables, differ minimally from those published earlier by the census office (Mansoor and Azzabi, 2000: 21).
4. Technically, it would be more appropriate to talk of proportions rather than ratios. But 'proportions' not only is linguistically more cumbersome, but also suggests identical denominators, which is not the case for the two quantities in point.

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