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Suspected Hazard Area Mapping in Non-Technical Landmine Surveys

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Suspected Hazard Area Mapping in Non-Technical Landmine Surveys

This article is a reference for individuals who are planning on performing non-technical landmine surveys of suspected hazard areas or for those individuals who plan to use such data. The author brings the process to life through this detailed account from the description of suspected hazard areas to mapping the data, to storing the data and improving its method.

by Rune V. Engeset, *Survey Special Advisor, SAC*

Introduction

Landmines and UXO cause human suffering and hamper social and economic development in many countries. To eliminate or reduce this problem, we need to measure the problem and define a strategy to tackle it. Mine action addresses this by a survey activity, of which there is a plethora of variants known as the general survey (formerly known as level one survey), Landmine Impact Survey (LIS), emergency survey and standards survey. Of these, the LIS is now becoming the standard approach. All of these methods collect data on areas of risk to the population—a risk caused by landmines or UXO. Information on the risk areas, called suspected hazard areas[1] (SHAs), is based on data already available, data collected by visual inspection from a safe viewing point and by using information volunteered by key informants. A wide range of mine action activities, such as impact assessments, national strategies, clearance and marking operations planning and conduct, mine risk education (MRE), and victim assistance depend on the SHA data as the key data entity. However, the survey investigation of SHAs may be carried out to different levels of detail. While the LIS maps a great deal of data on the social and economic attributes of an SHA, this article focuses on the most commonly applied methods for mapping the geographical aspects of SHAs. Particular attention is paid to how data is recorded in the field and stored and displayed in the Information Management System for Mine Action (IMSMA).

Suspected Hazard Areas

What are Suspected Hazard Areas?

An SHA is an area of real or perceived danger due to landmines or UXO. This area is defined by the perceptions of the community or key informants that may or may not be accurate. A non-technical survey does not entail any physical investigations of the presence or geographical limitations of the risk area. That is different from what can be achieved through inspecting the site from one or more safe viewpoints outside the reported hazard area. The person with the best knowledge of the area and its landmine/UXO contamination accompanies these visits.

SHAs are typically locations of confrontation or defence and are often found on the slopes of hills, around former military positions, within transportation networks (roads, airports, railroads), at water points and riverbanks, and around infrastructure such as buildings and distribution networks for electricity, water, oil and gas.

The information available to the survey originates mainly from key informants in the nearby communities, military, police, health personnel, etc. Besides relying on information volunteered from key informants, the survey personnel may visit the site and collect further detailed data by investigating current patterns of land use, vegetation and terrain, as well as by understanding the conflict history of the site.

What is the Role of SHAs in Non-Technical Surveys?
Both the general survey and LIS collect data on SHAs as their basic entity. However, the LIS furthers the general survey methodology. It adds a procedure to aggregate SHA data in the associated affected communities by calculating an impact score and focusing on the collection of a community profile through a structured community group interview.
In LIS, a community impact score is calculated from SHA data only, and a standard is developed for recording the contributing data: suspected ordnance types, impact categories and victims having an accident during the previous 24 months. However, due to increased focus on community-based data and narrow time frames, most country LISs collect less detailed physical data on the SHAs as compared to what could be expected from a general survey.

Which Main Data Categories Apply?
Data collected on SHAs in non-technical surveys are categorised as follows:

- Identification: name and description of area and access
- Geometry: viewing point, starting point, boundary and area size
- Ordnance
- Impact: impaired access to cropland, pasture, other land, water, houses, roads and infrastructure
- Terrain and vegetation
- Marking and clearance
- Recent accidents and victims
- Photographs and sketch maps

The geometry category data is collected for most SHAs through a range of different procedures. The main focus of this paper is the collection, recording and display of geometry data, because LIS practices vary considerably from one country to another and this data category is the key to further analysis, decisions and actions.

Which Geographic Entities are Mapped?
Four main geographic entities may be recorded during the survey (shown in Figure 1), ordered in increasing level of potential danger to the surveyors as the SHA is approached. In no case, in the non-technical surveys discussed in this article, should a surveyor enter an SHA or proceed without primary concern for safety.

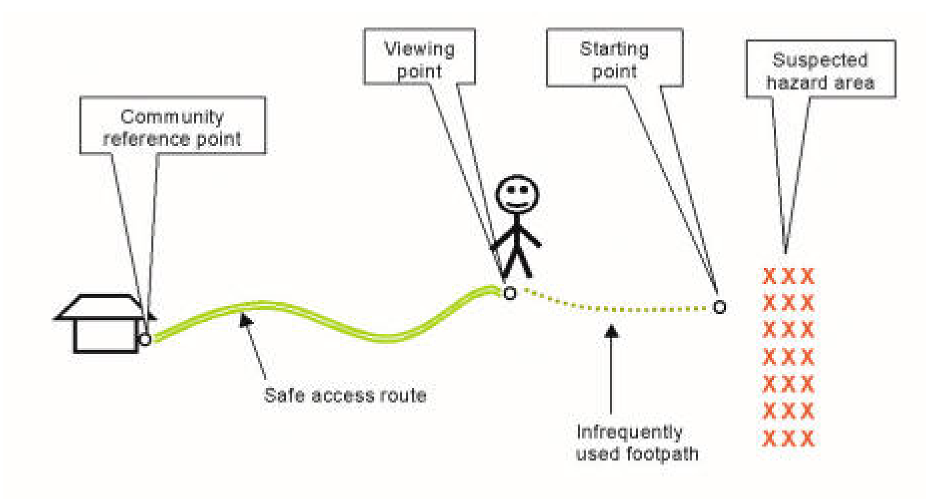

Figure 1: This map diagram shows the main geographic entities of a community, viewing point and suspected hazard area.

Community
First, the location of the community is fixed by the Global Positioning System (GPS). The location is typically a well-known reference point or merely the location where the interview is carried out. For instance, the northwest corner of the main religious building in the village may be recorded and geo-referenced.

Safe Viewing Point
Second, the survey team may carry out a visual inspection from a viewing point closer to the SHA and fix its location by GPS. This point must have safe access and provide a good overview of the SHA. A well-informed guide can provide access and further details on the SHA.

Starting Point
Third, the survey team will estimate the location of the starting point, which is the closest point of the SHA. This is done from the safe viewing point. From that viewing point, the bearing and distance to the starting point are estimated and the position of the starting point is calculated.

The locations of the viewing point and the starting point are identical at many sites. For example, the survey team visits views of the SHA, a plot of undeveloped land, from a tarmac road. The danger starts where the tarmac ends, so the starting point is the viewing point.

SHA Area
Fourth, the extent of the SHA may be described. The detailed extent of the SHA is described based on direct observations or on indirect map-reading, visual interpretation and a dialogue with the key informant. The extent is defined either by direct or indirect observations of the recorded SHA boundary.

The definition of the SHA extent or boundary ranges can be the precise perimeter of the contaminated ground or, on the other hand, a vaguely defined transitional zone between perceived dangerous ground and perceived safe ground. For instance, the SHA may be on a clear-cut pastureland with well-defined borders against a forest that is not used by the surrounding community due to suspicion of mines. Often the local people know where the suspected hazard starts and the direction in which it stretches but are not precise on how far the danger continues. Or, rather, they may point out a large area where they know fighting took place or that hosted military camps. A survey team would record this as a large SHA, even though the contamination may be confined to small pockets within the SHA. To deal with these problems, the LIS methodology could be developed so that the survey teams classify SHAs according to their levels of boundary definition, degree of contiguousness or level of contamination.

In addition to these four entities, the single most important geographic variable is the size of the SHA. The size figure is used for assessing required resources and time to clear, delimit or mark SHAs. Size data varies greatly in accuracy and precision. It may be estimated by GPS, map or visual observations or recorded from key informants' statements.

SHA Mapping in the Field

Which Methods are Used?
The depth of the SHA investigation is carried out at one of three levels:
1. Based on the community interview only
2. Based on a visit at a viewing point
3. Based on a viewing point visit by a survey team with mapping capacity (Figure 2)

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Figure 2: Thailand LIS field teams visiting SHAs with key informants.

First Method: Community Interview

SHA data is collected during the community interview without a visit to the SHA location. The SHA location is estimated by asking key informants for the distance and direction of the SHA. The estimation of the size of the area depends solely on the information conveyed by the key informants. This method is applied if limited survey time is allocated to the visual inspection activity, due to road inaccessibility or security concerns. Survey teams always gather information at this level—further detail and reliability are achieved when proceeded by a visit to the SHA according to the next two methods.

Second Method: Visual Inspection

SHA data is collected from a safe viewing point located as close as deemed safe to the SHA and reached via a safe access route. The location of the viewing point is recorded using GPS. The size estimate is refined through a dialogue between key informants and the survey team during the observation of the area. In addition to fixing the location of the viewing point, the closest point of the SHA is estimated by taking the bearing and distance from the viewing point. The first and second modes of operation are common to most country LIS operations.

Third Method: Visual Inspection and Mapping

SHA data and boundary information are recorded from one or more viewing points. All or parts of the SHA boundary are fixed using a topographic map in combination with GPS and a compass. The size estimate is refined, controlled and re-estimated when the SHA boundaries are drawn as a polygon on the topographic map. The use of knowledgeable key informants results in a large improvement through detailed and open dialogue over the SHA. The survey teams require good map-reading skills for interpretation of the SHA placement in the terrain using maps, GPS and compass. This approach was taken in the Thailand LIS, as well as in many general survey operations.

How are These Methods Implemented in the Field?

Community Interview

The community interview method is quicker and more predictable than the other two, as no visits to the SHAs reported during the community interview are required. Little knowledge is needed of maps or positioning, but one needs to know how to read coordinates of a GPS receiver.

As no visual study is done in the field, all recorded data depends on the information provided by the group during the community interview. However, a number of problems face the survey team: detecting misunderstandings between the survey team and the group is often difficult; the description of an area out of sight is, in many cases, far less precise than a description on sight; and the survey team tends to be confused about the explanations given.

When the SHA is out of sight, the survey team has less of an opportunity to further investigate the information provided by sorting out unclear or even wrong responses. Also, villagers may be more tempted to exaggerate the scope of the problem and the size of the SHA when no visual investigation is carried out. The size estimate is taken from the villagers, who may have very limited experience in making such guesses, especially when asked away from the SHA site. The opportunity to stimulate discussion and explore all potential SHAs affecting the community is lowered when the survey team does not have a map of the terrain or an understanding of the conflict history in the area.

Visual Inspection

The visual inspection method, where the survey team visits a location near the SHA, requires caution. Well-informed key guides from the community and a safe transportation plan from the community interview site to the viewing point are necessities.

Without the mapping activity (see the next paragraph), visual inspection produces an estimate of the direction and distance to the start of the SHA from the viewing point. An estimate of the size of the area is given and a sketch of the SHA may be drawn.

The position of the starting point may be estimated by two methods: directly from one viewing point (direction is taken using a compass and distance using the rule of thumb[2] or a laser distance meter) or by taking the direction from two or more viewing points with known coordinates (from GPS) and calculating the position using triangulation.[3] Triangulation may also be used for estimating the locations of other edge points on the SHA in order to improve the estimate of the SHA size and description of its perimeter. Variants of this method are found in surveys, such as the northern Iraq and the Bosnia-Herzegovina LISs, where triangulation was used to estimate the location of two points at opposite edges of the SHA rather than one starting point only.

Visual Inspection and Mapping

The method of visual inspection and mapping, where due diligence is on having a basic mapping capacity in the survey team, enables the shape and extent of the SHA to be recorded. This requires that reasonable topographic maps (map copy) or ortho-rectified aerial (satellite) photographs are available at scale 1:100,000 or better.

Figure 3 illustrates such a map copy used by one of the Thailand LIS teams and shows how the position of the key locations could be recorded by GPS and how they are plotted on the map in the field. A compass was used to align the map with the North.

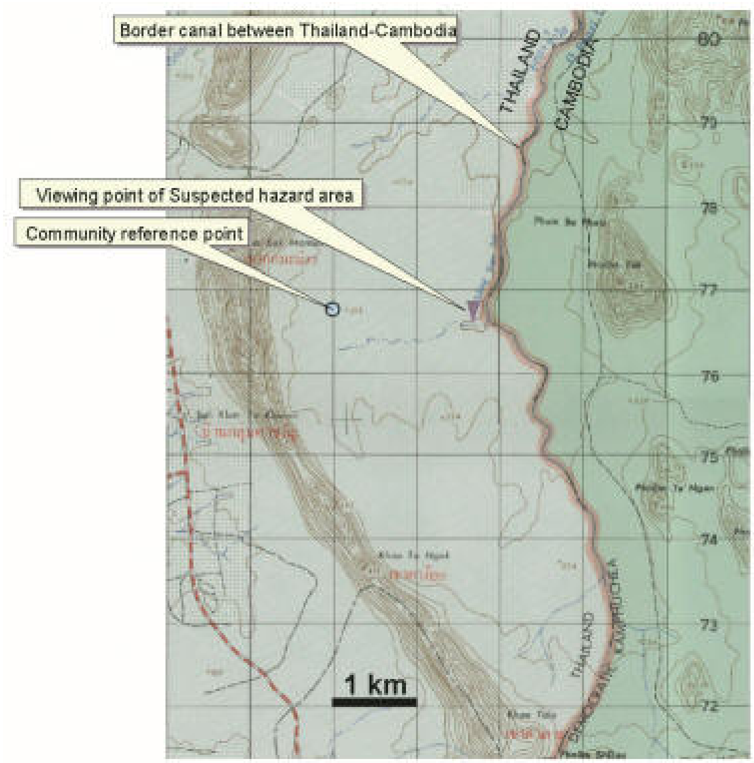

Figure 3: This map diagram shows an example of a topographic map scale 1:50,000 used by Thailand LIS teams. The survey teams use a GPS receiver to fix the superimposed community reference point and viewing point.

When topographic maps are provided to teams with basic map-reading skills, a number of topographic and infrastructure features are easily identifiable in the terrain and on the map. These features may delimit or can be used to structure the recording of the SHA boundaries. Such visible features that encompass SHAs are often rivers or lakes, roads, bridges, railroads, runways, slopes of hills, international borders, houses and power lines. Also, the patterns in the change of vegetation or land use across the SHA boundary often express the location and shape of the SHA boundary.

All of these boundary positions can be recorded as a line or polygon on the topographic map, or by fixing safe viewpoints around the SHA using GPS. For example, in Thailand, a large number of well-defined agricultural plots could be delimited in this manner, and during the general survey in Angola, a number of well-defined SHAs could be recorded

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along the roads or at bridges.

When visual inspection is carried out, the survey team visits a location near the SHA. A common effort to describe the SHA and its key features that are relevant to further mine action is often taken by both drawing a sketch map of the area and producing digital photographs of the area.

Linear Features

Some SHAs are similar to linear features rather than to polygons—e.g., suspected roads, railroads, riverbanks, pipelines and distribution networks, which are important to map using the method of visual inspection and mapping. These are best represented as linear features when using the typical uncertainty of non-technical positioning techniques (handheld GPS receivers and topographic maps on the scale 1:100,000 or more) and sources of information.

topographic maps are required in order to record the start, end and shape. Visiting two viewing points at different sites along the SHA is useful; also, key informants from the affected communities should be engaged. By nature, these features often connect a number of communities. Thus, one SHA impacts many communities. All communities that have potential access to the SHA are visited and investigated. The reported impact may vary from community to community. Visual inspection and mapping are carried out where safe access is provided.

Infrastructure features are often shown on the topographic maps. For example, roads are often built before or between conflicts. These roads are important features to include on the topographic maps. Roads are, thus, included on topographic maps during the initial survey, or during one of many revisions on the topographic map sheets. topographic features such as terrain and bodies of water, change very slowly, and the main targets for revisions are infrastructure and built-up areas. Communities tend to stop using a road due to the threat of landmines after a conflict. As the road is recorded on the map already, it is possible for the survey teams to identify and record the segment of the road that is no longer in use.

The adverse effects of major roads, railroads or electricity grids out of operation after a conflict supersede the negative impact measured in individual communities by the impact score. The geometry of these linear features must be recorded in order to better assess the impact, as well as the potential for socio-economic development in dealing with these sites.

The aggregation of the community impacts and the regional development potential are best assessed when the interconnectivity is presented in a geographic information system (GIS). Presenting the linear SHA features on maps together with community impact and other thematic data is important for rehabilitation or repatriation initiatives that would assess feasibility and impact of follow-up activities to mine action.

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